Insight vs IES on a Net-Zero Project: Building Performance Modeling Best Practices

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About the speaker

Xiaofei Shen

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Architect/ Sustainability Engineer in AECOM New York. His effort has been devoted to crossing the line between artistic design and scientific method through parametric performance simulation, generative design optimization, and interactive data visualization.

LEARNING OBJECTIVES

WHY INSIGHT

Learn why the team determined to use Insight as one of the building performance analysis tools for future projects

INSIGHT USES

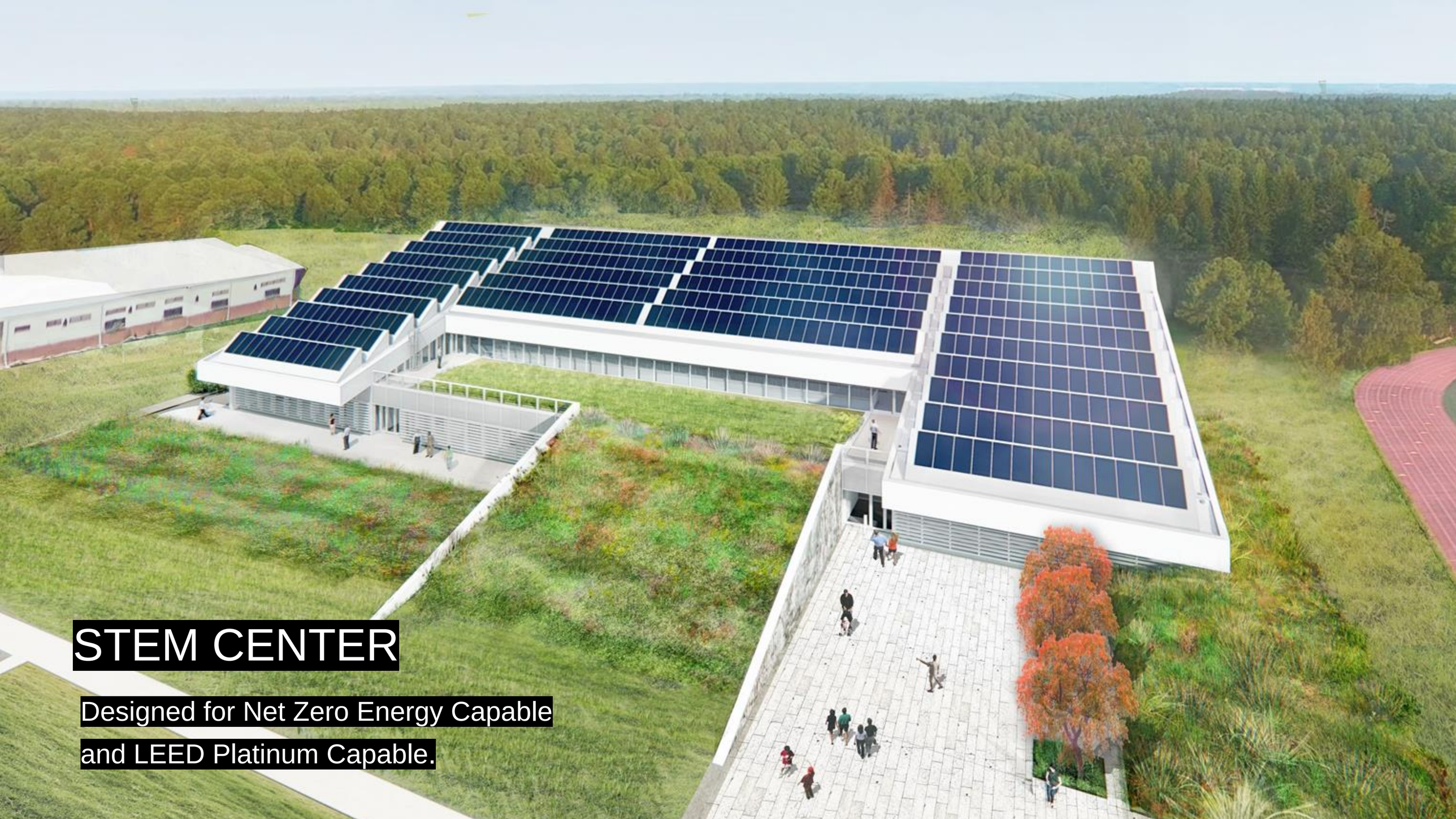
Discover how Insight and other tools were used in designing a net-zero project from concept to documentation

BEST PRACTICE

Explore the best approaches to modeling in Revit to achieve reliable simulation results from Insight

PICK N CHOOSE

Learn the pros /cons when comparing Insight, IES VE, and Honeybee, and select the tool that is right for your project


STEM CENTER
Designed for Net Zero Energy Capable
and LEED Platinum Capable.

WHY INSIGHT?

From Code Compliance to Net Zero Capable

Learn why the team determined to use Insight and other environmental performance analysis tools for future projects

Challenge 1 Net Zero Building Design

Challenge 2 Gap between BEM and BIM

WHY INSIGHT?

CHALLENGE 1

in Net Zero Building Design

When do we need a Building Energy Model (BEM)?

Type A

Energy Code Compliance

Type B

High Performance Design Optimization

Type C

Net Zero Energy Achievability Verification

Building Energy Model (BEM)
Type A Code Compliance Model

- DESIGN IS CONFIRMED
- PROCESS IS STRAIGHT FORWARD. SINGLE MODEL.
- ASSUMPTIONS ARE ACCEPTABLE

	Code Compliance		
Massing Design	confirmed		
Envelope Design	confirmed		
Layout/ Zoning	confirmed		
Building Profile	assumption		
Equipment Load/ Control	assumption		
Lighting Load/ Control	confirmed		
HVAC Type	confirmed		
HVAC Settings	confirmed		

Building Energy Model (BEM)
Type B High Performance Design

- DESIGN SHALL BE OPTIMIZED
- PROCESS IS BACK AND FORTH. MULTIPLE MODELS.
- ASSUMPTIONS ARE ACCEPTABLE

	Code Compliance	High Performance	
Massing Design	confirmed	optimized	
Envelope Design	confirmed	optimized	
Layout/ Zoning	confirmed	optimized	
Building Profile	assumption	assumption	
Equipment Load/ Control	assumption	assumption	
Lighting Load/ Control	confirmed	optimized	
HVAC Type	confirmed	optimized	
HVAC Settings	confirmed	optimized	

Building Energy Model (BEM)
Type C Net Zero Design

- DESIGN SHALL BE OPTIMIZED
- PROCESS IS BACK AND FORTH. MULTIPLE MODELS.
- ASSUMPTIONS SHALL BE PRECISE

- A typical Net Zero project usually requires additional time to design/ deliver.

	Code Compliance	High Performance	Net Zero
Massing Design	confirmed	optimized	optimized
Envelope Design	confirmed	optimized	optimized
Layout/ Zoning	confirmed	optimized	optimized
Building Profile	assumption	assumption	as built
Equipment Load/ Control	assumption	assumption	as built
Lighting Load/ Control	confirmed	optimized	optimized
HVAC Type	confirmed	optimized	optimized
HVAC Settings	confirmed	optimized	optimized

WHY INSIGHT?

CHALLENGE 2

in Bridging BEM & BIM

Three Questions

Question 1

A SEPARATE BEM MODEL IS ALWAYS NEEDED?

Question 2

SHALL WE HOLD OFF BEM UNTIL BIM IS FULLY READY?

Question 3

LACK OF UNIFORM BEM STANDARD IN BIM?

Question 1

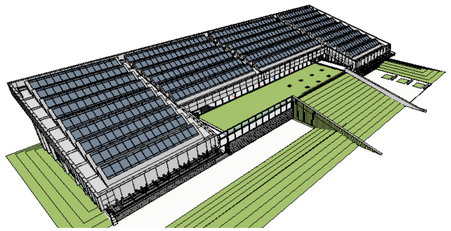
A SEPARATE BEM MODEL IS ALWAYS NEEDED?

NO

MUCH DUPLICATED EFFORT OCCURS WHEN EXCHANGING BETWEEN BEM AND BIM. NOT EFFICIENT!

- Revit offers an extensible medium for data storage which provides opportunities to include BEM parameters, so the separation can be avoided.
  - gbXML. Building data can be exchanged without repeating the work.
  - Insight. No exchanges between the models. Integrated simulation capabilities in BIM are available.
- TIME AND COST SAVING

Revit



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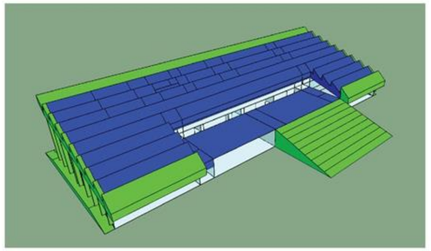
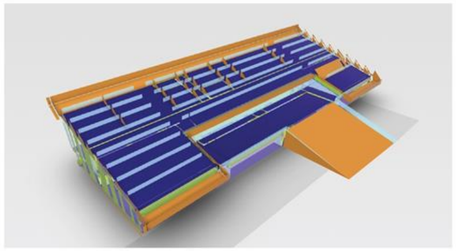


Insight



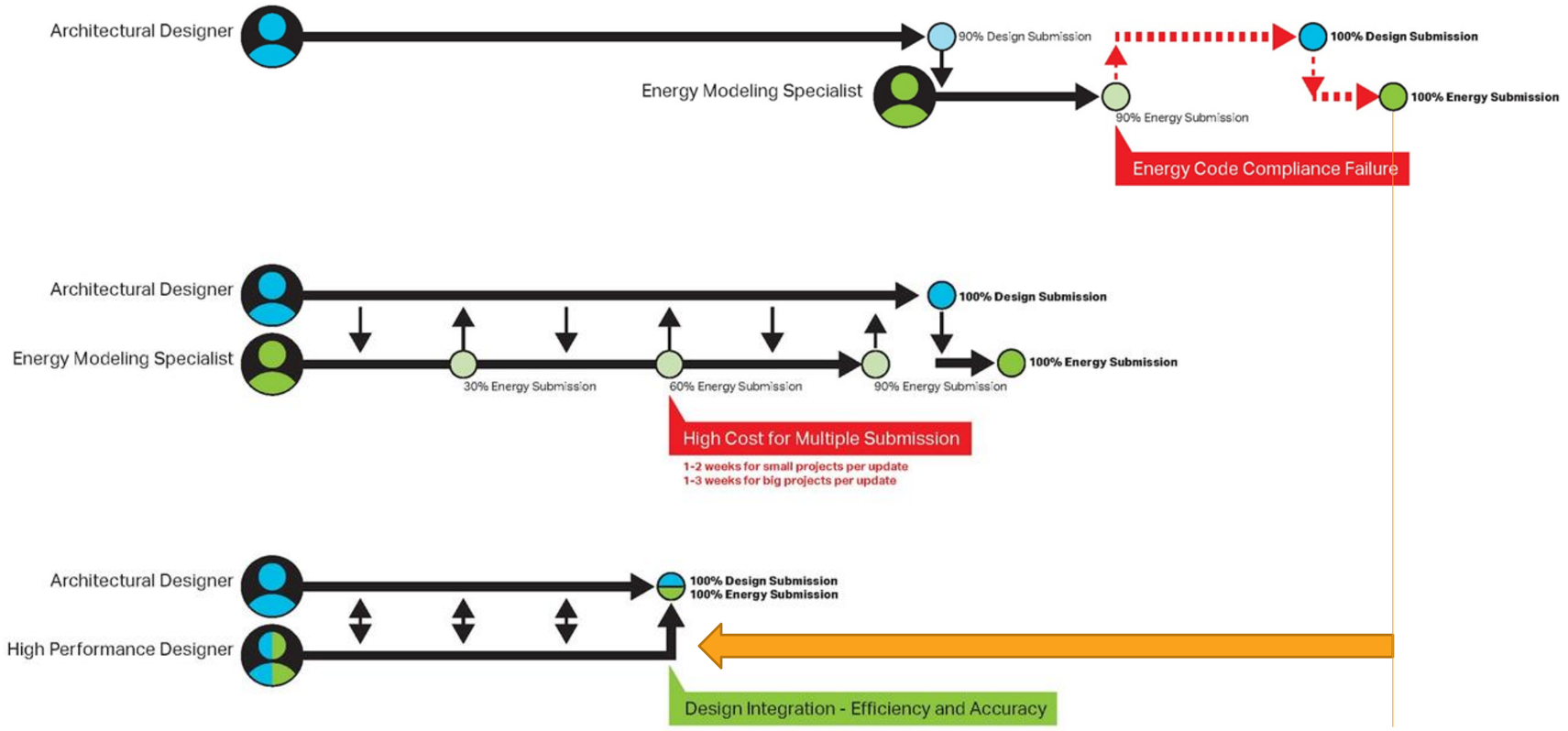
Question 2

SHALL WE HOLD OFF BEM UNTIL BIM IS FULLY READY?

NO

MOST BEM OCCURS WHEN NEARING BIM COMPLETION WHEN DATA IS COLLECTED. TOO LATE!

- BIM offers a platform where inputs and assumptions can be filled in the model directly, so the BEM can proceed earlier.
  - gbXML. Default energy settings with reasonable multi-disciplinary assumptions can be passed through for BEM at the early stage.
  - Insight. Different Level of Details (LOD) are acceptable which allows the BEM functionality to be integrated at different BIM stages.
- EARLIER AND BETTER ESTIMATES!



Question 3

NO UNIFORM BEM STANDARD IN BIM?

NO

NO ESTABLISHED BEM STANDARD IN BIM WHEN DEFINING PROPERTIES. ACCURACY NOT GUARANTEED!

- BIM provides the methodology to transfer information more effectively than multiple formats.
  - BIM templates. Pre-defined BIM templates can be utilized between different projects and professionals
  - Insight. A more integrated design tool without transferring the information.
- REDUCED RISKS

Revit Space

<Space Schedule>

A	B	C	D	E	F	G	H	I
Name	Space Type	Area	Area per P	Specified Lighti	Specified Powe	Outdoor Air p	Outdoor Air pe	Specified Exha
Admin	BBJ Admin	2968 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF	0.00 CFM
Barber	BBJ Multi-purpos	602 SF	10 SF	0.40 W/ft²	0.50 W/ft²	7.5 CFM	0.06 CFM/SF	0.00 CFM
Cell	BBJ Cell	65693 SF	40 SF	0.64 W/ft²	0.10 W/ft²	5.0 CFM	0.06 CFM/SF	1.00 CFM
Central Control	BBJ Central Contr	5910 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF	0.00 CFM
Children's Play	BBJ Community	1423 SF	10 SF	0.62 W/ft²	1.00 W/ft²	7.5 CFM	0.12 CFM/SF	0.00 CFM
Clinic	BBJ Medical	15475 SF	50 SF	0.56 W/ft²	5.00 W/ft²	15.0 CFM	0.00 CFM/SF	
Community	BBJ Community	36374 SF	10 SF	0.62 W/ft²	1.00 W/ft²	7.5 CFM	0.12 CFM/SF	0.00 CFM
Concourse	BBJ Corridor	108192 SF	1000 SF	0.41 W/ft²	0.10 W/ft²	0.0 CFM	0.06 CFM/SF	0.00 CFM
Conference	BBJ Admin	1636 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF	0.00 CFM

eQuest Space

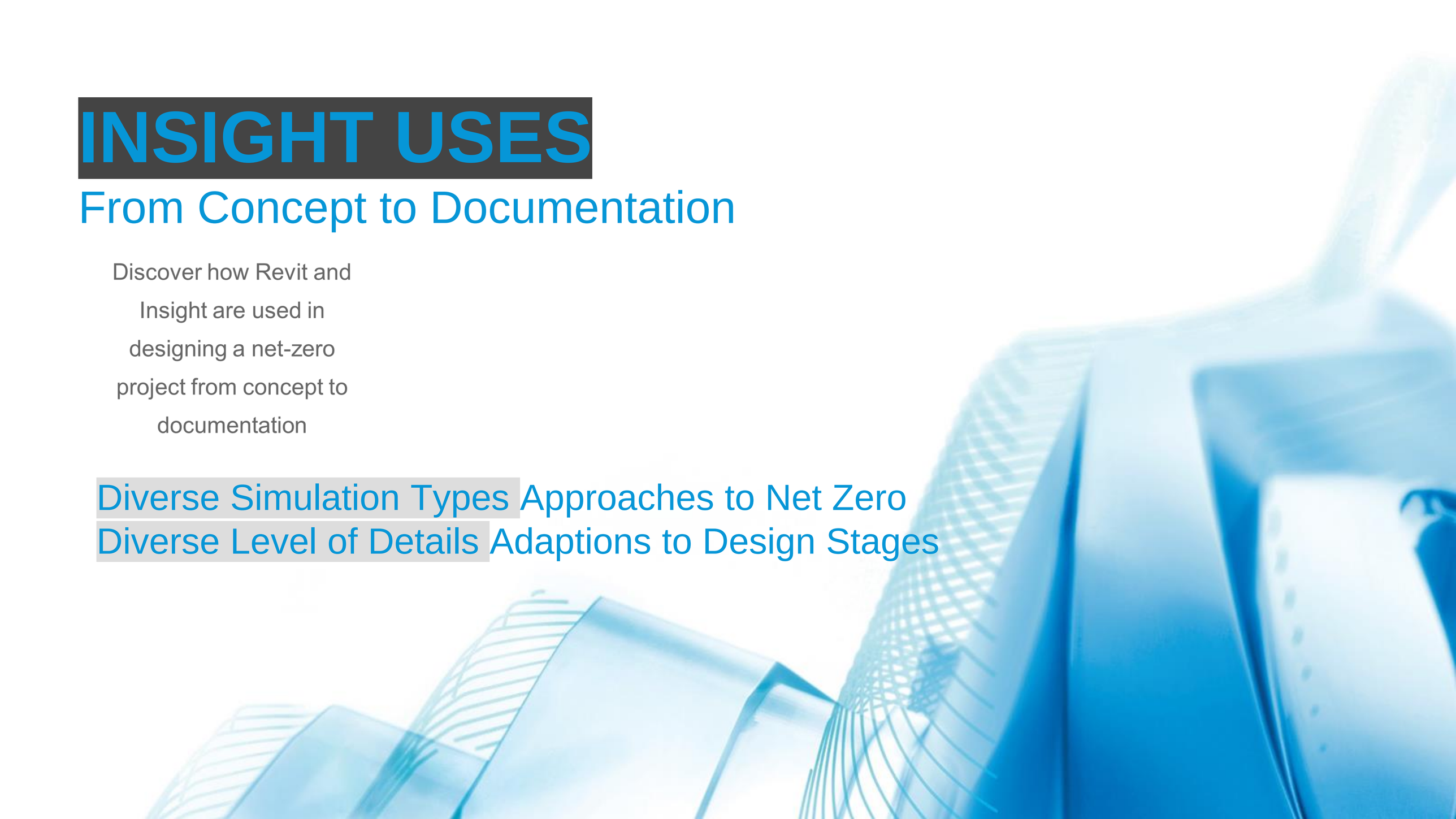
	Space Name	Parent Floor	Activity Desc.	Occupancy Schedule	Area/Person (ft2)	Number of People	Total Ht Gain (Btu/h-person)	People Sens (Btu/h-person)	People Lat (Btu/h-person)
45	EL3 (FL3) Nurse's Office	EL3 Third floor	Healthcare - Exam	OFFICE-OCC-YR	58	1.00	450	250	200
46	EL1 (FL1) Warming Pantry	EL1 First floor	Food Preparation A	KITCHEN-OCC-YR	200	11.00	450	275	275
47	EL2 (FL2) Exercise Room	EL2 Second floor	Exercise Room	GYM-OCC-YR	17	31.00	450	710	1,090
48	EL1 (FL1) Domestic Water S	EL1 First floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
49	EL1 (FL1) Refuse/Recycle	EL1 First floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
50	EL2 (FL2) Telecom	EL2 Second floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
51	EL2 (FL2) Electrical Closet 2	EL2 Second floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
52	EL3 (FL3) Electrical Closet 3	EL3 Third floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200

INSIGHT USES

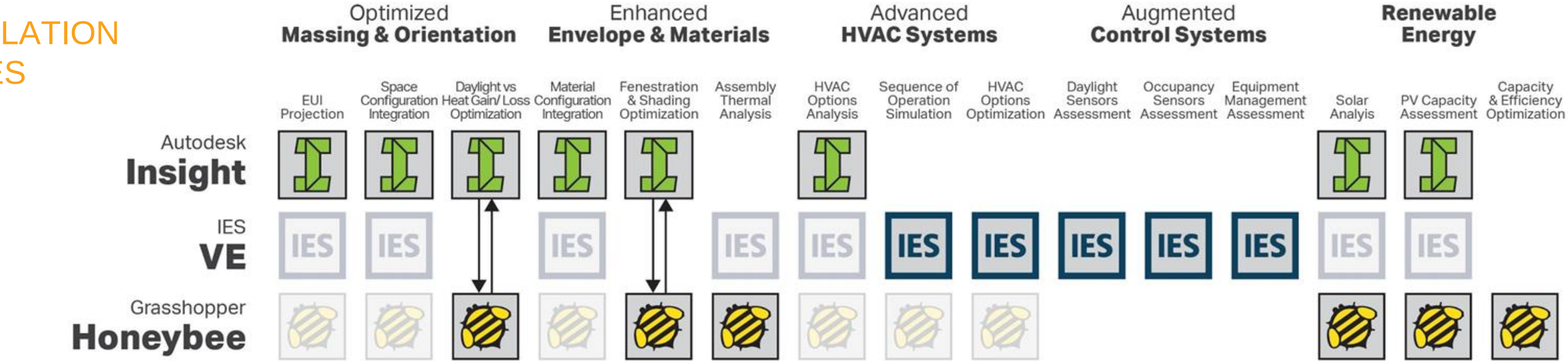
From Concept to Documentation

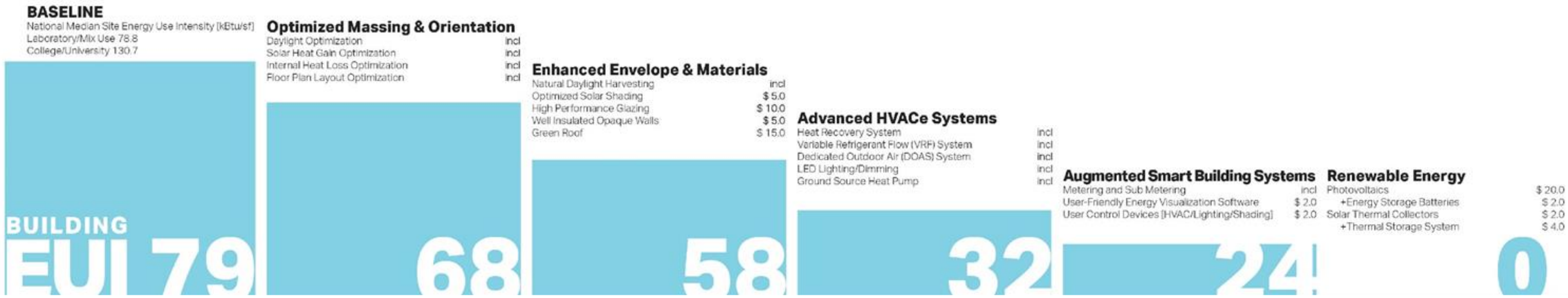
Discover how Revit and Insight are used in designing a net-zero project from concept to documentation

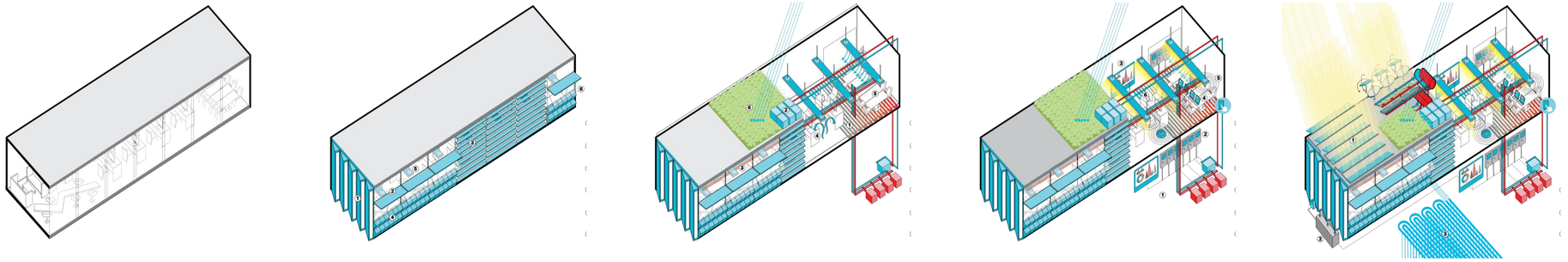
Diverse Simulation Types Approaches to Net Zero
Diverse Level of Details Adaptions to Design Stages



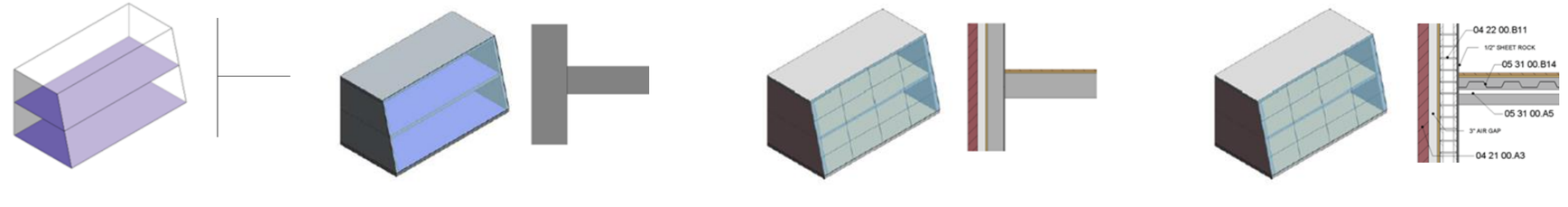
SIMULATION TYPES



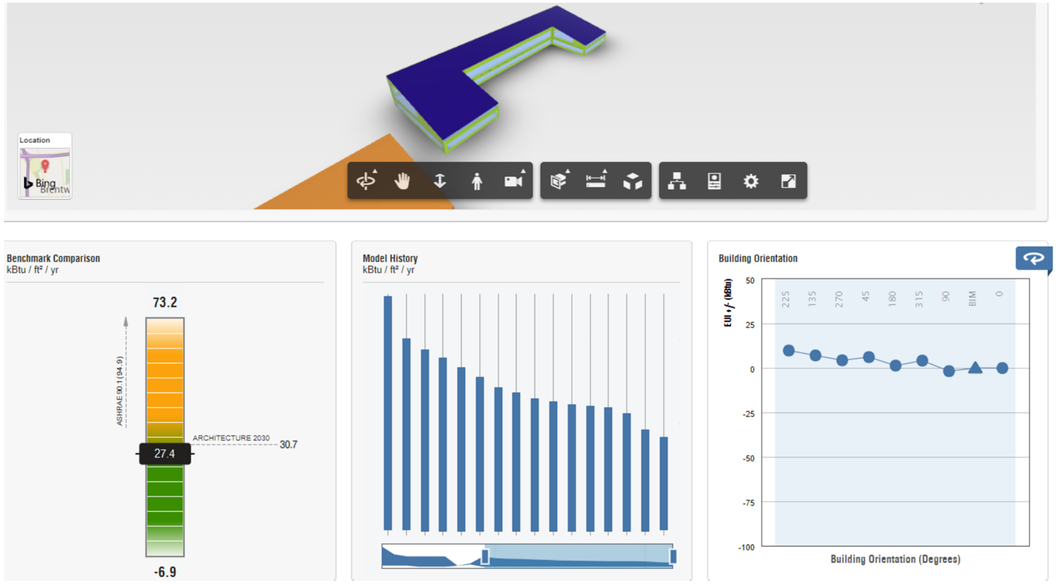


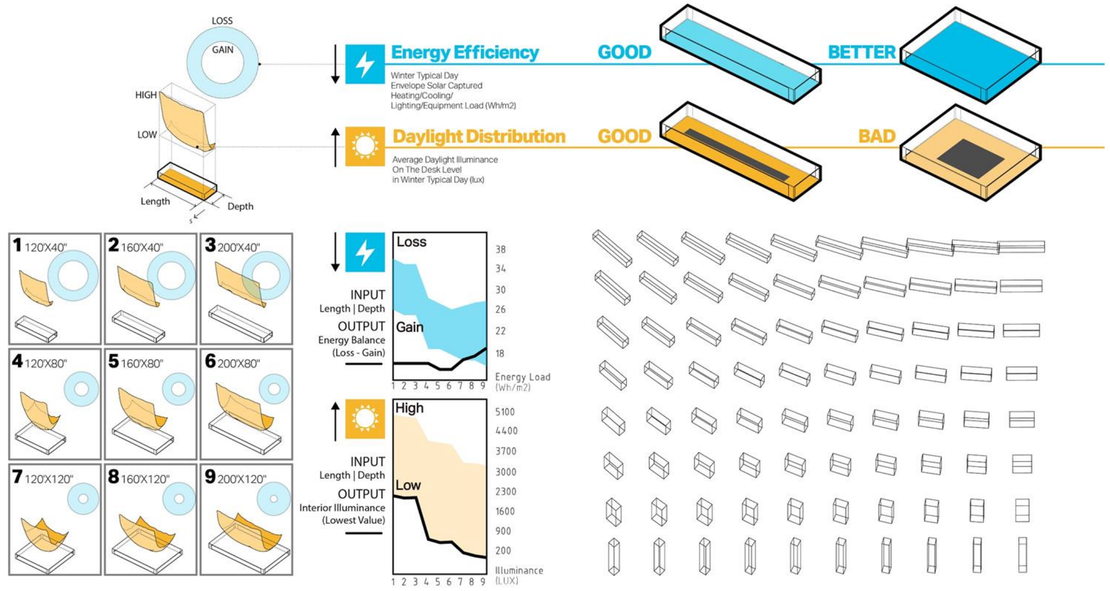


LEVEL OF DETAILS



LOD100 PRE-DESIGN	LOD200 PRELIMINARY DESIGN	LOD300 DETAILED DESIGN			LOD400 CONSTRUCTION DOCUMENTATION
Early Projection	Preliminary Analysis	Integration	Architectural Optimization	Engineering Simulation	Documentation
Climate Alignment					
Solar Radiation Analysis	PV Capacity Assessment	*PV System Optimization & Configuration*			
EUI Projection					
Sustainability Goal Setting					
	Massing Orientation Analysis	*Massing Orientation Optimization*			
	Window-to-Wall % Analysis	Fenestration Optimization			Glazing Configuration
		Shading Design Optimization			Shading Configuration
	Facade Thermal Performance	*Facade Construction Thermal Analysis*			*Facade Assembly Specification*
					Glazing and Wall Schedule Documentation
	Space Configuration	Space Utilization (schedule, occupancy)			Space/ Room Schedule Documentation
	Lighting Power Density Analysis	Photometrics Study			Lighting Fixture Configuration
		Daylight & Occupancy Sensor Simulation			Lighting Schedule Documentation
	HVAC Types Analysis	*HVAC Options Optimization*			*HVAC System Configuration*
		HVAC *Sequence of Operation Simulation*			HVAC Description
					HVAC Equipment Documentation



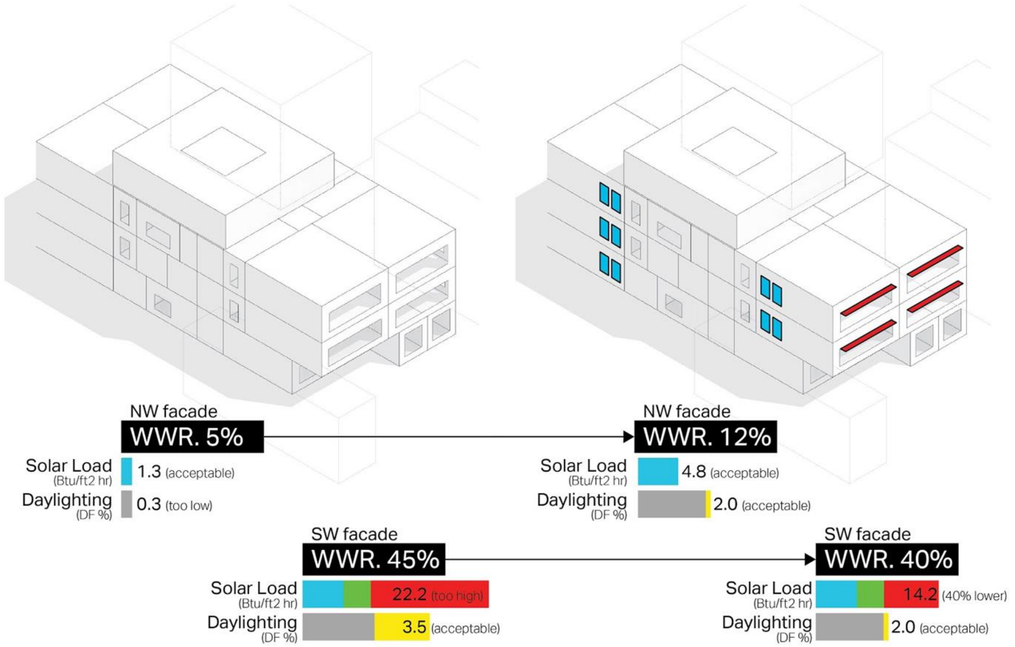


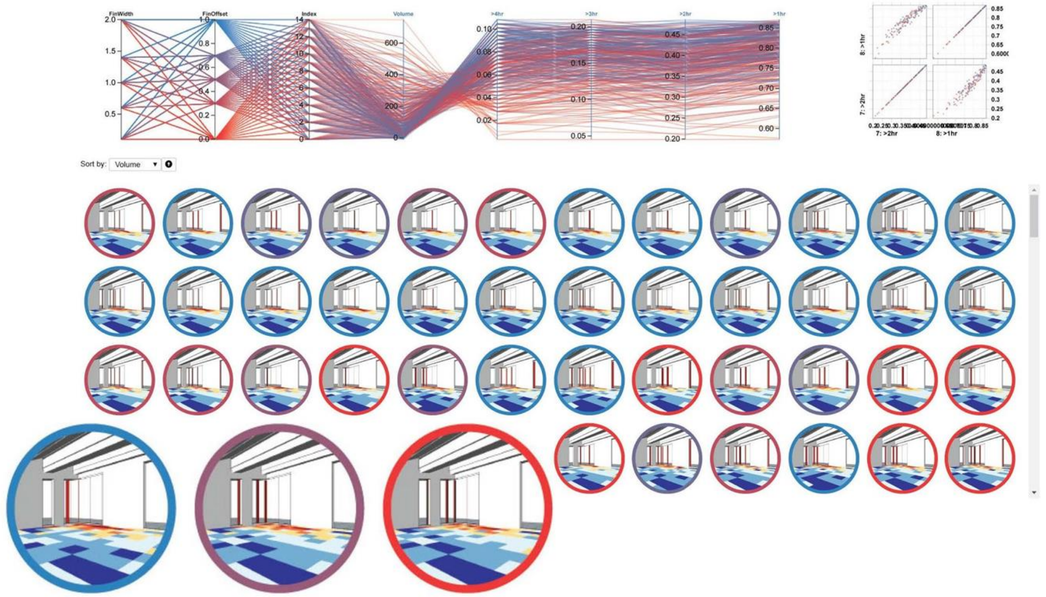
Massing LOD 100

- Massing Orientation
- Energy Projection

Massing LOD 200

- Design Optimization
- Daylight and Heat Gain/ Loss Trade-off





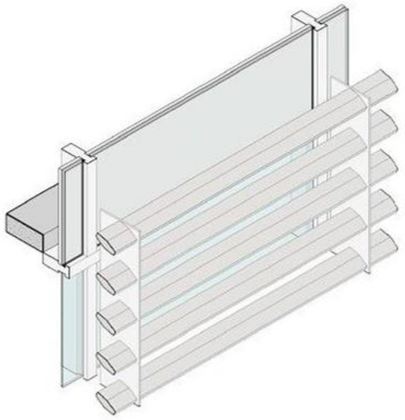
Facade LOD 200

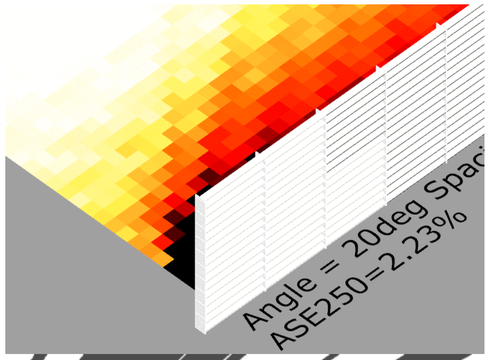
- Window-to-wall Ratio
- Thermal Properties - glazing types, wall constructions

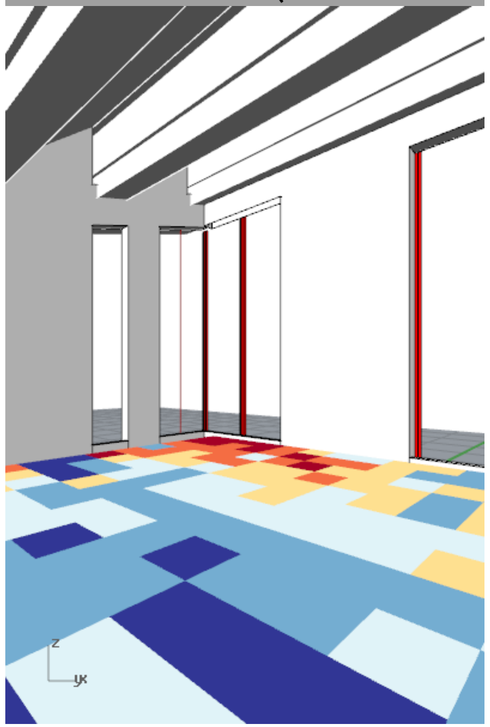
Facade LOD 300

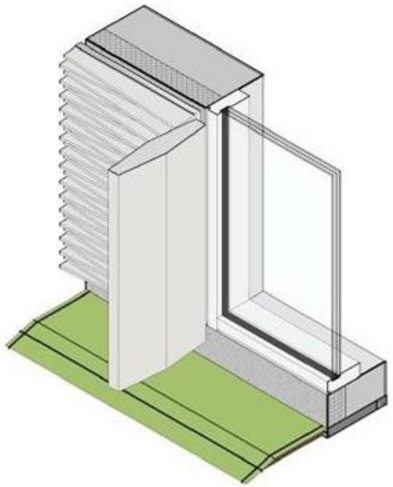
- Geometry Optimization - solar shades, insulation thickness
- Daylight and Heat Gain/ Loss Trade-off

Facade Design Optimization









Daylight Analysis Metric

Annual Sunlight Exposure (ASE$_{1000,250}$)

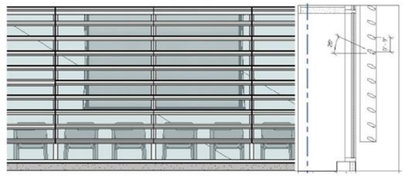
describes the potential for visual discomfort in interior work environments.
% of the floor area that is exposed to >1000 lux of direct sunlight for >250 hours per year

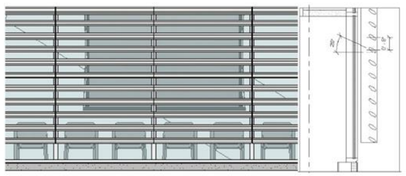
Current Scenario

9" Spacing
25 deg tilted

Proposed Scenario

8" Spacing
35 deg tilted





[LEED Daylight credit requires **ASE$_{1000,250}$<10%**]

Symposium
ASE$_{1000,250}$=17%

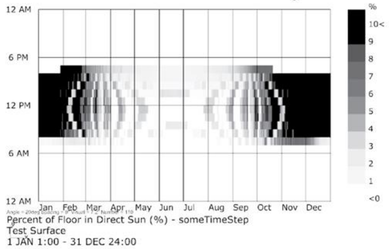
Multi-use Lab
ASE$_{1000,250}$=16%

Symposium
ASE$_{1000,250}$=8%

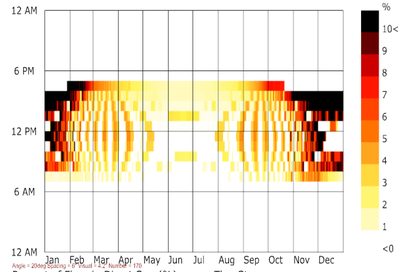
Multi-use Lab
ASE$_{1000,250}$=5%

ASE$_{1000,250}$ fail
ASE$_{1000,250}$ pass

% of the floor area in Direct Sun every hour



Percent of Floor in Direct Sun (%) - someTimeStep
Test Surface
1 JAN 1:00 - 31 DEC 24:00



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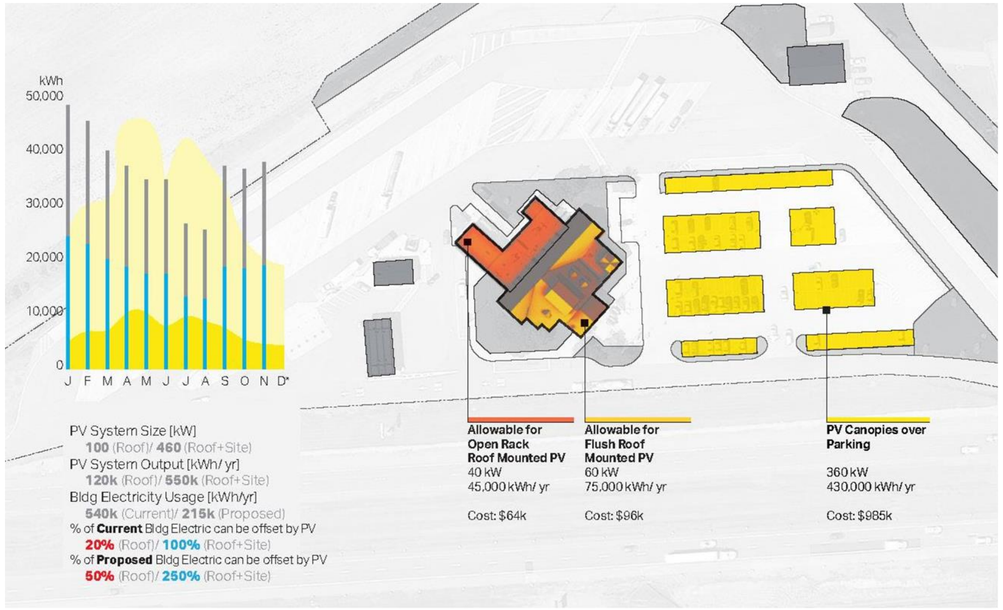
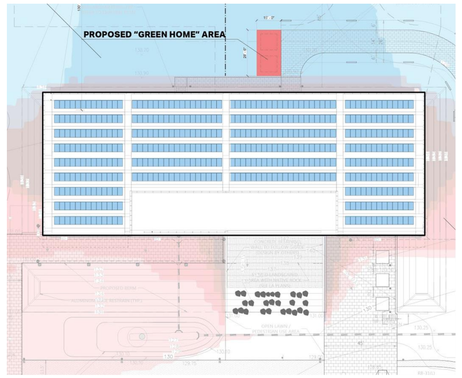
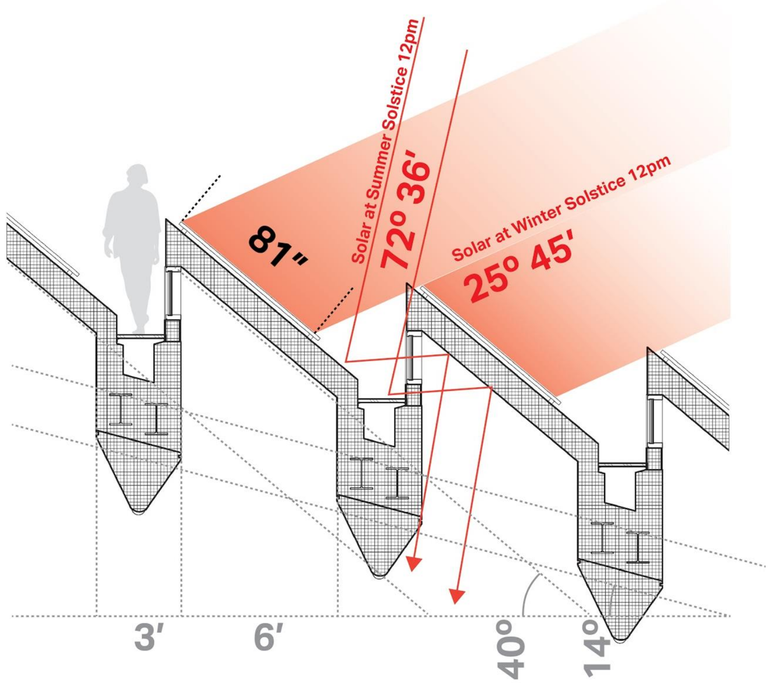




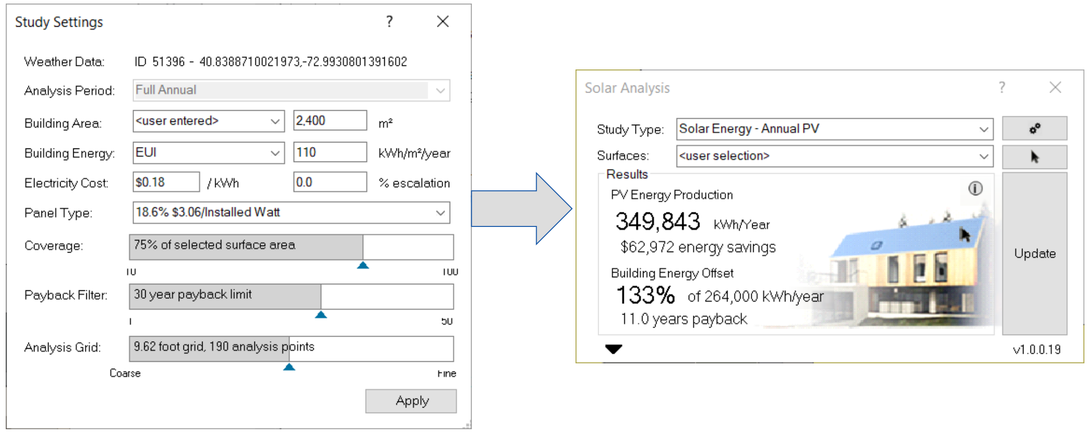


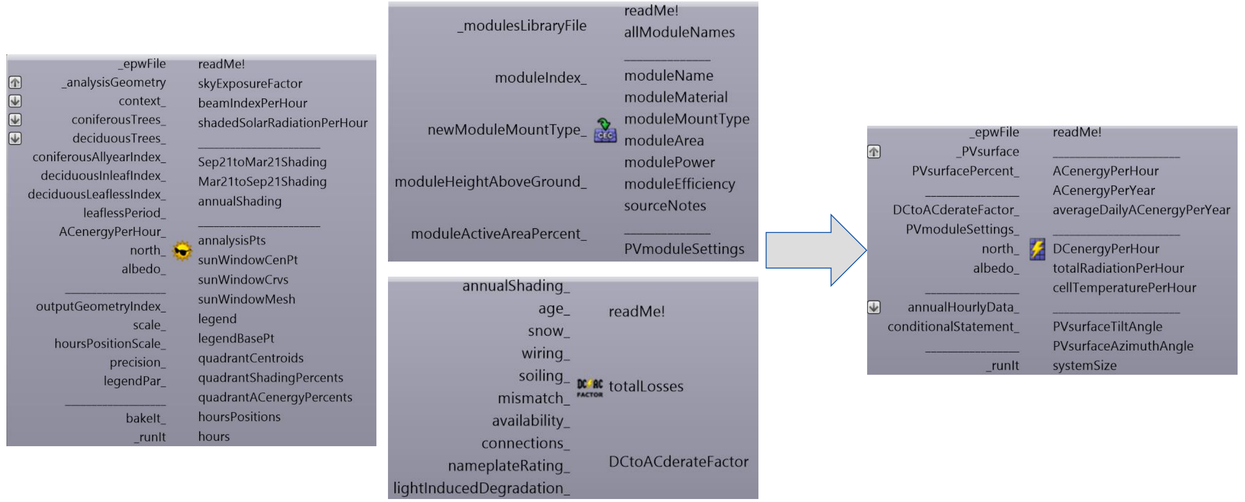
PV LOD 200

- Solar Radiation Analysis
- PV Capacity Assessment

PV LOD 300

- PV System Optimization - Orientation, Tilt, Layout
- PV System Configuration - capacity and efficiency
- Payback Years Assessment





PV LOD 200

- Weather Data
- Analysis Period
- Three Pre-set PV Settings
- Surface Selection
- Fixed Context Shading

PV LOD 300

- Weather Data
- Analysis Period
- Customized Real PV Modules
- Surface Selection
- Dynamic Context Shading
- System Loss Factor

METHODOLOGY

How we ensure the best results?

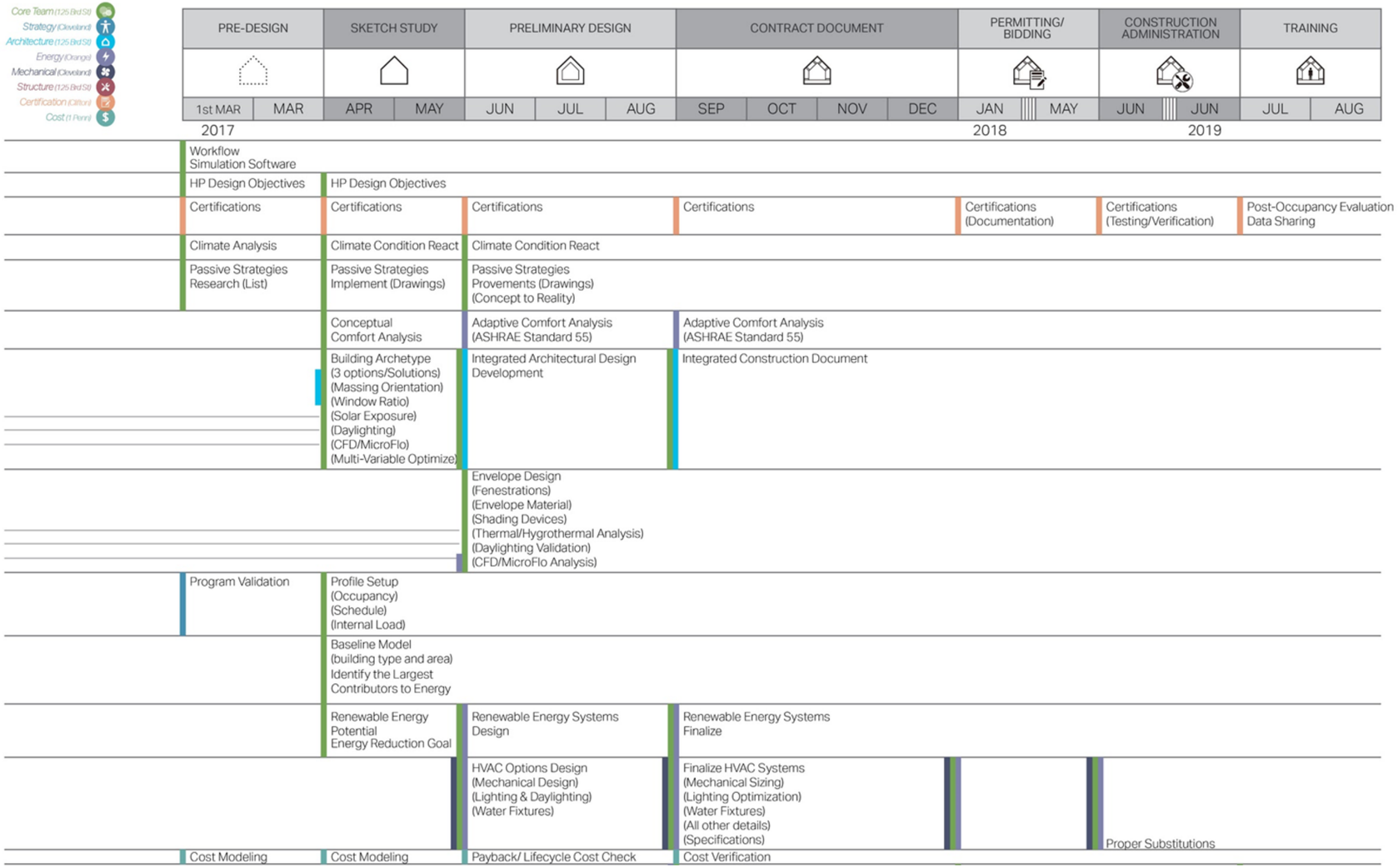
Discover the best approaches to modeling in Revit for reliable environmental simulation results

Responsibilities Clarify BEM Roles in BIM
Standards Well Defined Building Elements
Best Practices Well Structured BIM Model

METHODOLOGY

RESPONSIBILITIES

Clarify BEM Roles in BIM



BIM/ BEM roles need to be clearly defined in each design stage. For example, architects own the settings of the geometry, but energy modelers can take the control of the materials if the person has the specialties on this.

Client

Design Criteria Approval;

Energy Goals Approval;

Architect/ Engineer

Design Criteria Setups;

Review Model Issues;

High Performance Designer

BEM Simulation;

Energy Goals Verification;

BEM/ BIM Standard

BIM Manager/ BIM Coordinator

BEM/ BIM Templates;

BIM Coordination;

Client

Design Criteria Approval;

Energy Goals Approval;

Architect/ Engineer

Design Criteria Setups;

Review Model Issues;

High Performance Designer

Energy Goals Verification;

BEM Simulation;

BIM Manager/ BIM Coordinator

BEM/ BIM Templates;

BIM Coordination;

LOD100
PRE-DESIGN

Building Code Check;

Design Criteria Setups;

Program Matrix;

Room Date Sheet Develop;

Climate Analysis;

EUI Projection;

Energy code/ Performance Goals verification;

Project BIM Global Setup;

Import Previous BIM/ BEM Templates;

Client

Design Criteria Approval;

Energy Goals Approval;

Architect/ Engineer

Design Criteria Setups;

Review Model Issues;

High Performance Designer

Energy Goals Verification;

BEM Simulation;

BIM Manager/ BIM Coordinator

BEM/ BIM Templates;

BIM Coordination;

LOD200
PRELIMINARY DESIGN

Programming Stacking;

Setup the building geometry and Rooms in Revit with internal loads and occupancy schedule assumptions defined;

Massing Orientation Analysis;

Facade Glazing % Test;

Conceptualization on Facade assembly, fenestration and shadings, and HVAC options

Setup default BEM parameters for primary family types (walls, glazing, floors, roof, rooms, spaces)

Client

Design Criteria Approval;

Energy Goals Approval;

Architect/ Engineer

Design Criteria Setups;

Review Model Issues;

High Performance Designer

Energy Goals Verification;

BEM Simulation;

BIM Manager/ BIM Coordinator

BEM/ BIM Templates;

BIM Coordination;

LOD300
DETAILED DESIGN

Preferred Facade Suppliers;

HVAC Sizing and Sequence of Operation;

Daylight Analysis;

Finalize facade thermal/ daylight performance;

Setup the Spaces in Revit with data transferred from Rooms;

Energy modeling within Insight and/ or exported to IES VE for HVAC design optimization;

Setup BEM schedules for daylight/ energy reports and design documentation;

Client

Design Criteria Approval;

Energy Goals Approval;

Architect/ Engineer

Design Criteria Setups;

Review Model Issues;

High Performance Designer

Energy Goals Verification;

BEM Simulation;

BIM Manager/ BIM Coordinator

BEM/ BIM Templates;

BIM Coordination;

Code Compliance Checking;

Product Specifications;

Code Compliance Modeling;

Finalize Daylight Reports;

Finalize Energy Reports;

Final Deliverables Coordination;

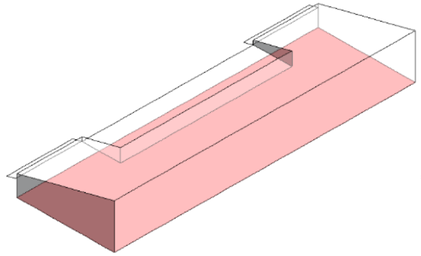
BIM/ BEM Templates Updates;

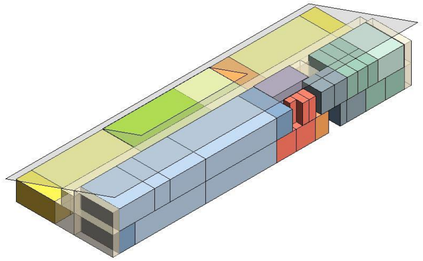
METHODOLOGY

STANDARDS

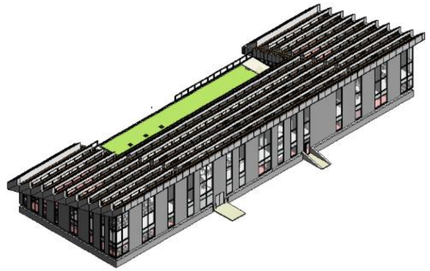
Well-Defined Building Elements

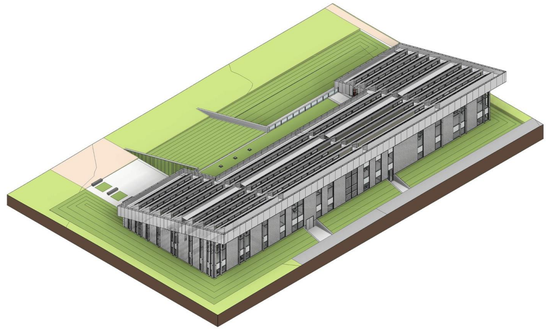
BEM Conceptual



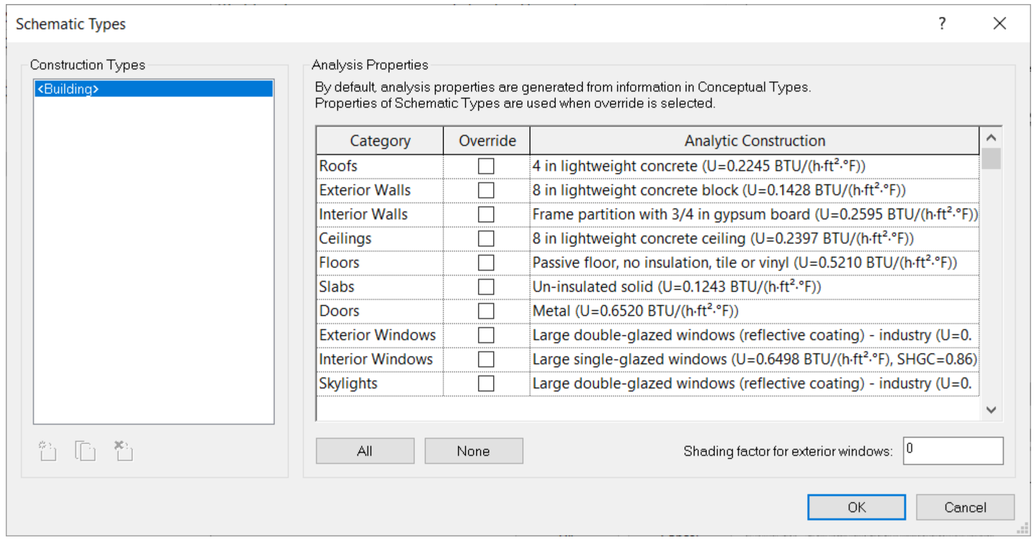


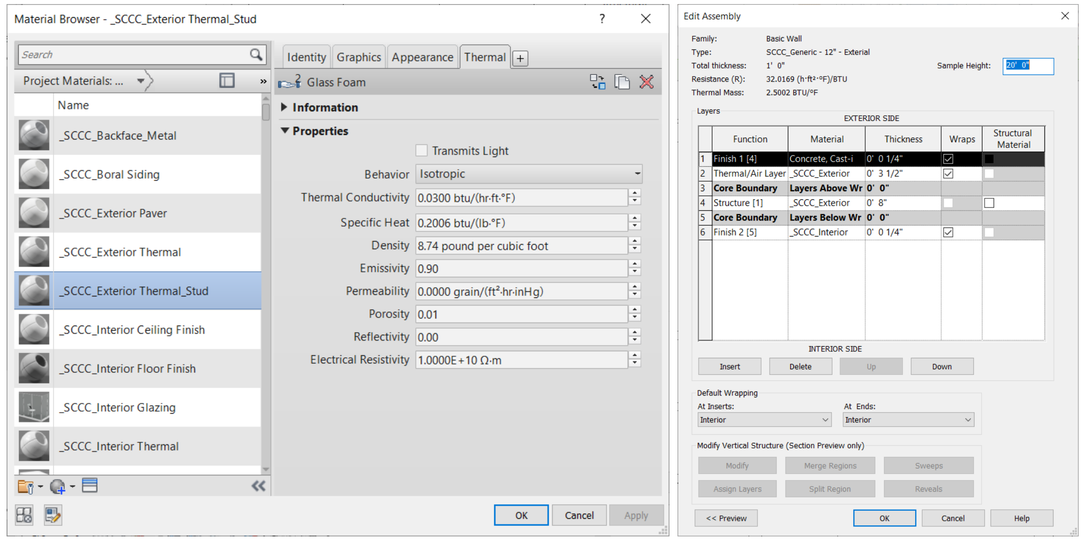
BEM Detailed





LOD100 PRE-DESIGN	LOD200 PRELIMINARY DESIGN	LOD300 DETAILED DESIGN	LOD400 CONSTRUCTION DOCUMENTATION
● **Early Projection** ● Location and context; ● Facade types; ● Building Type: Building level thermal profile and occupancy;	● **Preliminary Analysis** ● Spatial geometry; ● Facade properties; ● Space Type: Space level thermal profile and occupancy; ● Method of servicing. heating/ cooling/ ventilation;	● **Simulation/ Optimization** ● Fixed spatial geometry; ● Detailed facade construction; ● Fixed building profile; ● Servicing schedules. sequence of operations;	● **Integration/ Documentation** ● Fixed spatial geometry; ● Facade thermal bridging/ infiltration; ● Fixed building profile; ● Fixed sequence of operations;





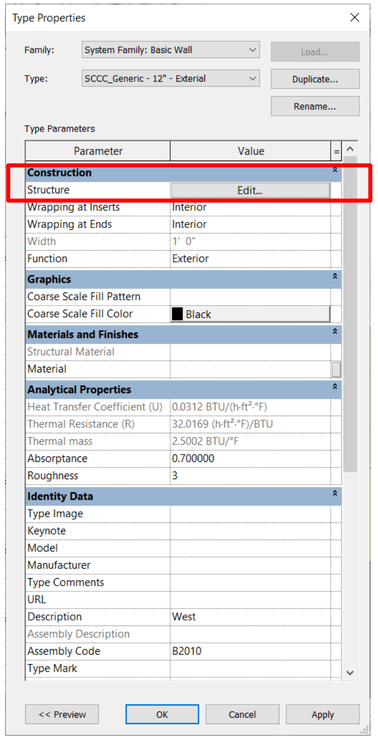
Envelope LOD 200

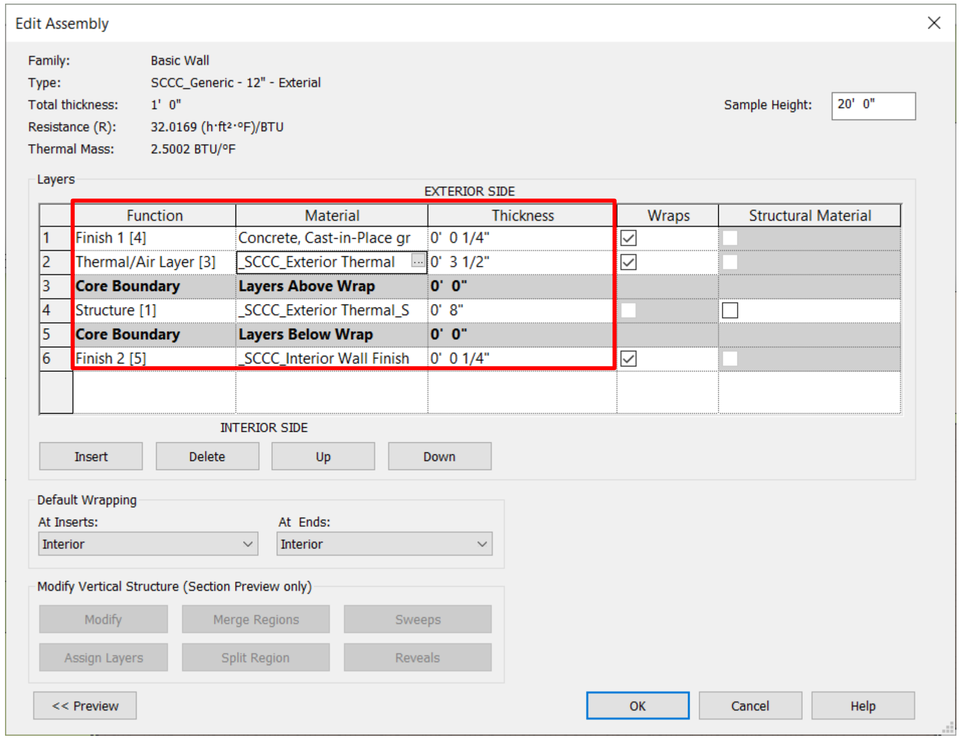
- **Construction defined in Energy Settings**
- Energy Settings - Advanced - Other Options - Material Thermal Properties - Schematic Types

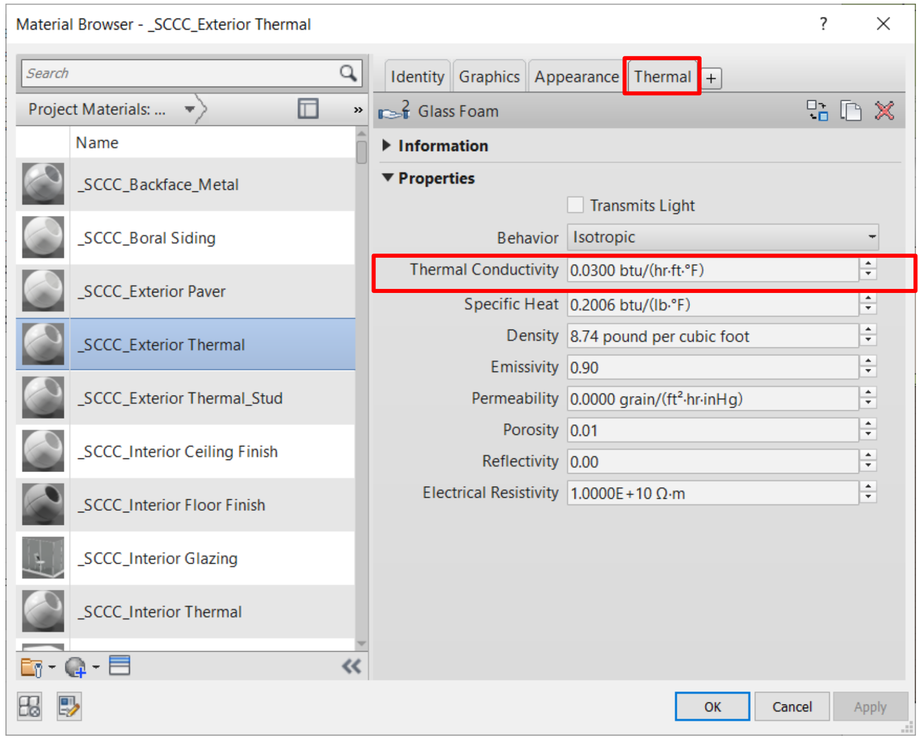
Envelope LOD 300

- **Construction modeled with material thermal properties**
- Properties - Construction - Structure - Edit Assembly - Material - Thermal

Envelope Thermal







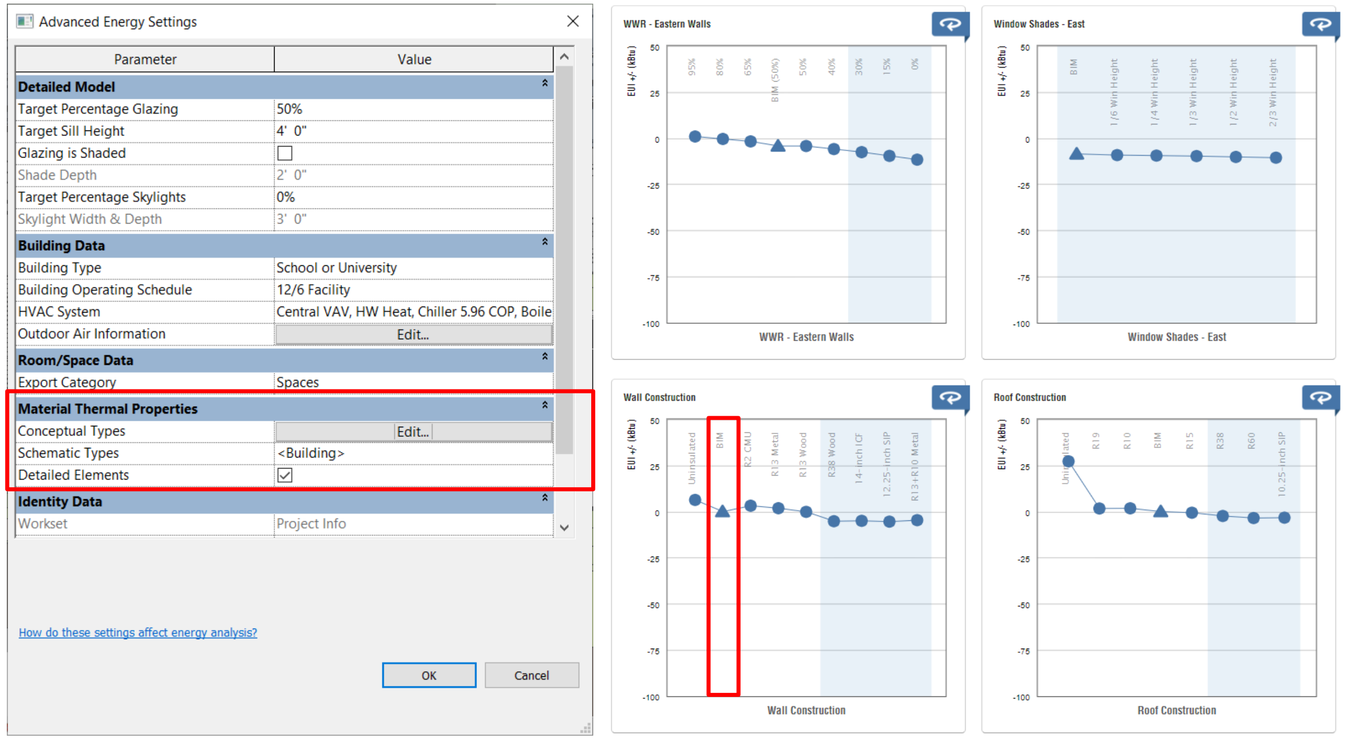
Construction Settings.

Edit Assembly: Assembly Layers.

Material Settings.

Material Browser Thermal Tab. Swap out different assets for each material or edit the properties.

Envelope Thermal

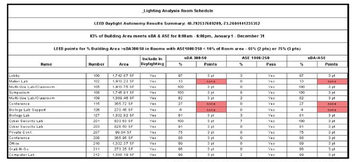


Energy Settings. Check Detailed Elements.

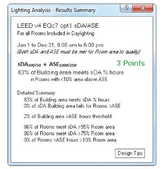
Revit will use the thermal properties assigned to each element and those results will be represented in the “BIM Settings” triangle in each Insight factor.

Envelope Daylight

SCCC - LEED - sDA/ASE Results Summary
First Floor

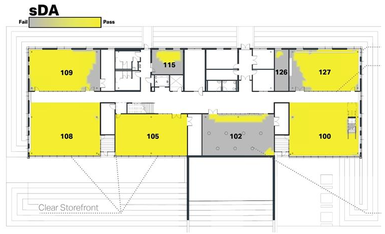


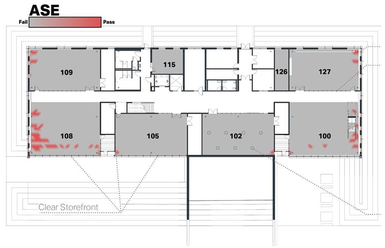
the Control Center is not considered as regularly occupied space. The campus technician will only be on site once a week to check the system.



To determine compliance with LEED v4 EQ credit Daylight, Option 1 Simulation: Spatial Daylight Autonomy and Annual Sunlight Exposure, the project team has performed a series of annual computer simulations using Revit's daylighting analysis tool. The sDA/ASE Results Summary here shows the software output summary, which indicates that 83% of the building area (that is considered regularly occupied) meets both sDA300/50% and ASE1000,250 requirements. The report summary notes that the results meet the 75% threshold for 3 credit points.

The SDA-ASE Results Table is the software output of the project's regularly occupied spaces and notes where the spaces meet/do not meet sDA300/50% and/or ASE1000,250 requirements. Seven solar tubes are proposed to the Maker Lab on the first floor.





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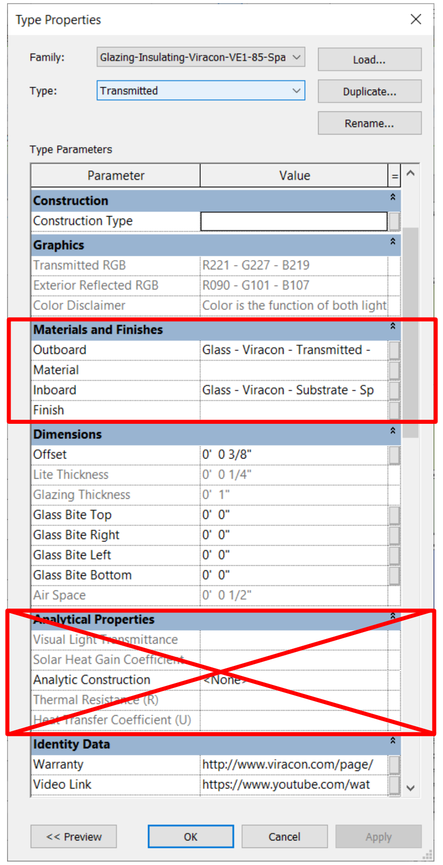
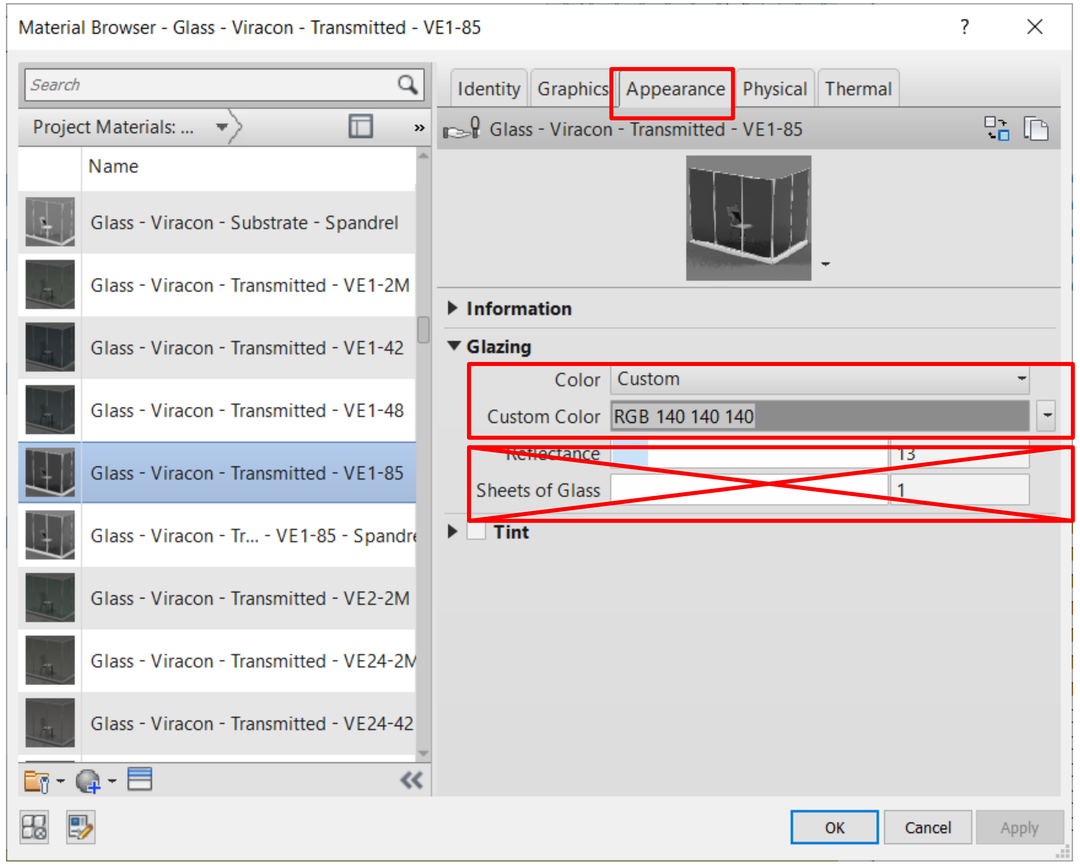
04 | 26 | 2019





Analytical properties are for energy analysis, not illuminance analysis

Tvis properties are defined by changing the custom color

Envelope Daylight

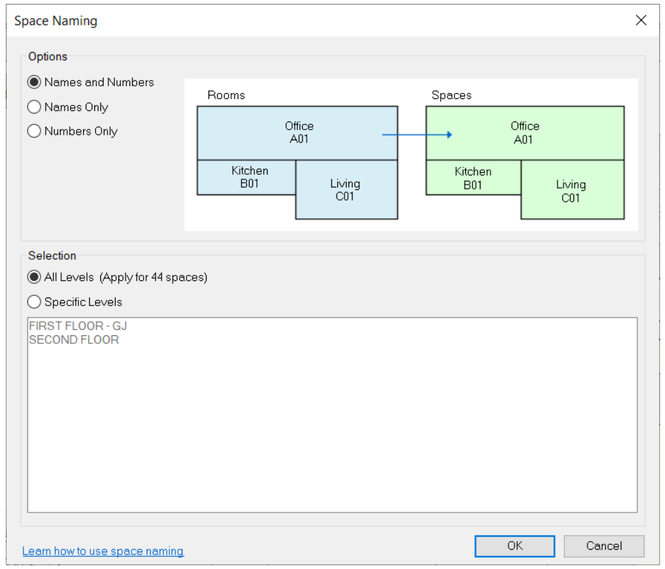
Tvis properties are defined by changing the custom color

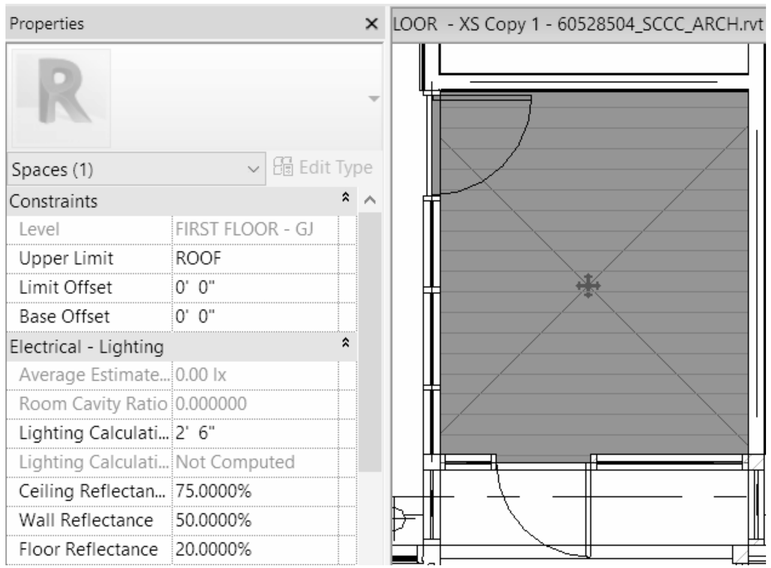
- determine # of panes in the model
- determine the thickness of window pane
- determine the Tvis value
- set color of glass material to RGB values

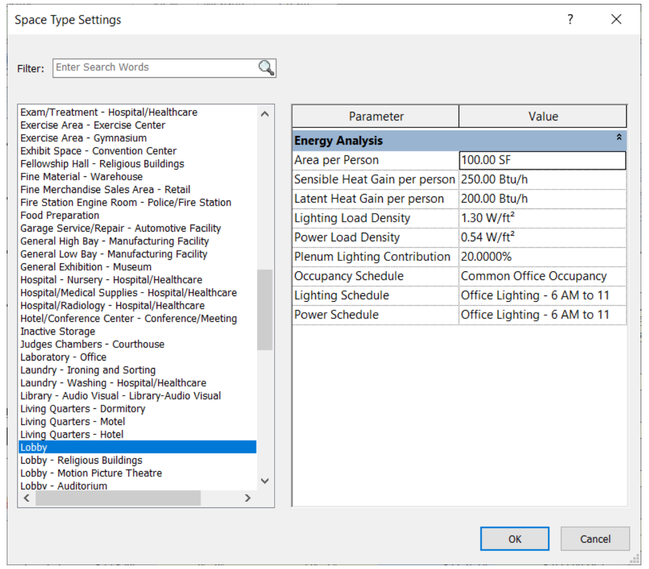
R,G,B	Tvis								
	Thickness	90%	80%	70%	60%	50%	40%	30%	20%	10%
single	3.0 mm	171	24	2	0	0	0	0	0	0
	4.0 mm	189	43	8	1	0	0	0	0	0
	5.0 mm	201	61	16	3	0	0	0	0	0
	6.0 mm	209	78	25	7	1	0	0	0	0
	8.0 mm	219	105	45	17	5	1	0	0	0
	10.0 mm	226	125	64	29	11	3	0	0	0
	12.7 mm	232	146	86	47	22	9	3	0	0
	25.4 mm	243	193	148	109	76	49	27	12	3
	28.6 mm	244	199	157	120	87	59	35	17	5
dual	3.0 mm	-	154	50	14	3	0	0	0	0
	4.0 mm	-	175	76	29	9	2	0	0	0
	5.0 mm	-	189	96	44	18	5	1	0	0
	6.0 mm	-	198	113	59	28	11	3	0	0
	8.0 mm	-	211	139	86	48	24	9	2	0
triple	3.0 mm	-	-	137	58	21	6	1	0	0
	4.0 mm	-	-	160	84	39	15	4	0	0
	5.0 mm	-	-	175	105	57	27	10	2	0
	6.0 mm	-	-	186	121	73	39	17	5	0
quad	3.0 mm	-	-	224	118	55	21	6	1	0
	4.0 mm	-	-	232	143	81	40	16	4	0
	5.0 mm	-	-	236	160	101	58	28	10	1
	6.0 mm	-	-	239	173	118	74	40	17	4

Resource: Autodesk

Space Thermal







Definition

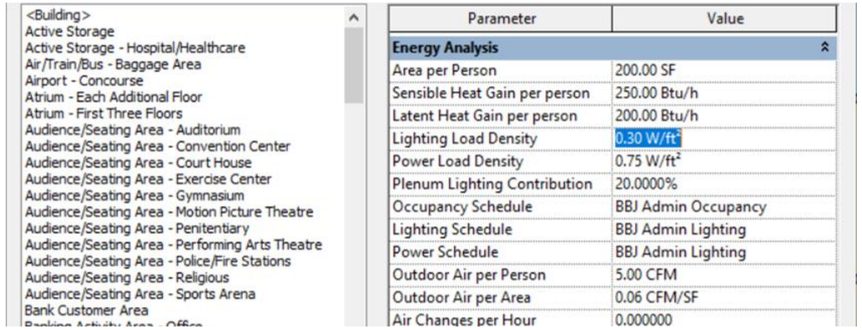
- Space Name
- Space Number
- Space definitions should be matching to room definitions and can be automatically transferred from rooms

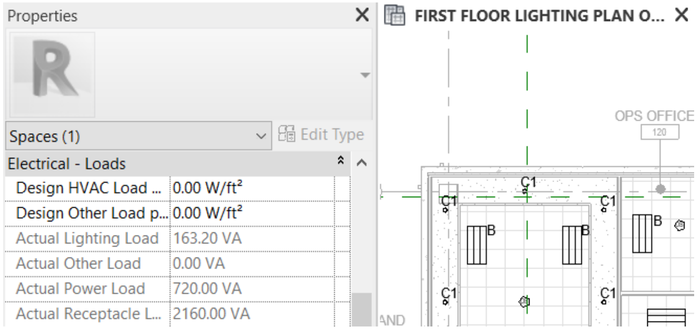
Geometry

- Space Area
- Space Height
- The walls, doors, and windows generating rooms, spaces, and zones should be defined as Room Bounding

Utilization

- Occupancy and Schedule
- Lighting and Equipment Power Density
- assigned usages and behavioral attributes should be defined via different Space Types





SPACE SCHEDULE

A	B	C	D	E	F	G	H
Name	Space Type	Area	Area per Per	Specified Lighting Load	Specified Power Load	Outdoor Air p	Outdoor Air per Area
Admin	BBJ Admin	2968 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF
Barber	BBJ Multi-purpose	602 SF	10 SF	0.40 W/ft²	0.50 W/ft²	7.5 CFM	0.06 CFM/SF
Cell	BBJ Cell	65693 SF	40 SF	0.64 W/ft²	0.10 W/ft²	5.0 CFM	0.06 CFM/SF
Central Control	BBJ Central Control	5910 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF
Children's Play	BBJ Community	1423 SF	10 SF	0.62 W/ft²	1.00 W/ft²	7.5 CFM	0.12 CFM/SF
Clinic	BBJ Medical	15475 SF	50 SF	0.56 W/ft²	5.00 W/ft²	15.0 CFM	0.00 CFM/SF
Community	BBJ Community	36374 SF	10 SF	0.62 W/ft²	1.00 W/ft²	7.5 CFM	0.12 CFM/SF
Concourse	BBJ Corridor	108192 SF	1000 SF	0.41 W/ft²	0.10 W/ft²	0.0 CFM	0.06 CFM/SF
Conference	BBJ Admin	1636 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF
Cooking	BBJ Multi-purpose	1430 SF	10 SF	0.40 W/ft²	0.50 W/ft²	7.5 CFM	0.06 CFM/SF

LIGHTING SCHEDULE

A	B	C	D	E	F	G	H
Space: Name	Count	Type	Manufacturer	Description	Model	Wattage	Apparent Load
FIRST FLOOR							
ADMIN CLERK	1	B	LITHONIA	VOLUMETRIC 2x4 LED	2BLT4-40L-ADSM-MVOLT-GZ10-LP835	61 W	32 VA
CAI CLASSROOM	1	C1	LITHONIA	4" ROUND OPEN LED DOWNLIGHT	LDN4-35/15-LO4-AR-LD-MVOLT-GZ10	8 W	20 VA
CL.	2	C1	LITHONIA	4" ROUND OPEN LED DOWNLIGHT	LDN4-35/15-LO4-AR-LD-MVOLT-GZ10	8 W	41 VA
CONFERENCE RO	15	C1	LITHONIA	4" ROUND OPEN LED DOWNLIGHT	LDN4-35/15-LO4-AR-LD-MVOLT-GZ10	8 W	306 VA
CORRIDOR	4	C1	LITHONIA	4" ROUND OPEN LED DOWNLIGHT	LDN4-35/15-LO4-AR-LD-MVOLT-GZ10	8 W	82 VA
ELEVATOR	2	K	LITHONIA	2' GASKETED LED	DMW2-L24-4000LM-ACL-WD-MVOLTZ10-35K-80	0 W	80 VA
ENTRY VESTIBUL	4	C1	LITHONIA	4" ROUND OPEN LED DOWNLIGHT	LDN4-35/15-LO4-AR-LD-MVOLT-GZ10	8 W	82 VA
JANITOR	1	C1	LITHONIA	4" ROUND OPEN LED DOWNLIGHT	LDN4-35/15-LO4-AR-LD-MVOLT-GZ10	8 W	20 VA

Lighting LOD 200

- LPD defined in each space
- Space Type Settings - Lighting Load Density
- Check in Space Schedule

Lighting LOD 300

- LPD calculated with actual lighting fixtures
- Electrical - Loads - Actual Lighting Load
- Check in Lighting Fixture Schedule

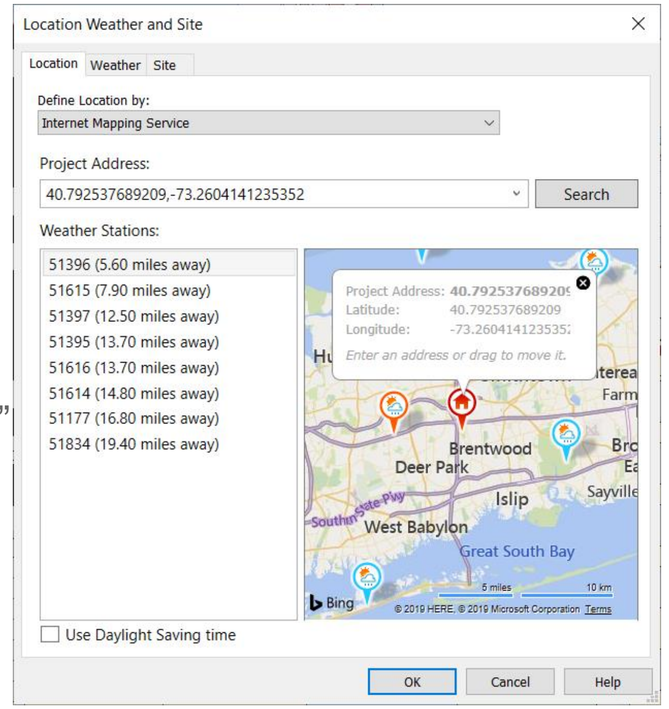
METHODOLOGY

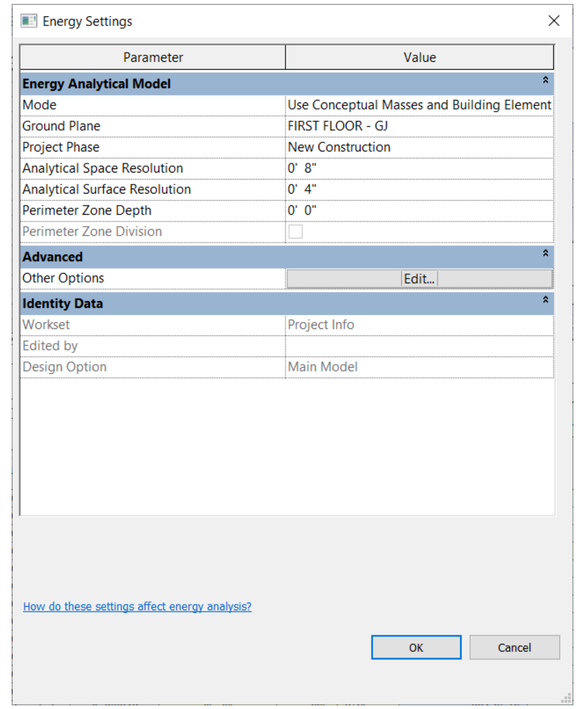
BEST PRACTICES

Well-Structured Building Model

Best Practice First Checklist

- Be sure to set Location
- Check True North/ Project North
- Check Energy Settings:
  - Be sure to set building type
  - Always use the combined mode
  - Try to set the analytical space/ surface resolution to 8”/ 4”
- Specify ground plane
- Check if the facade thermal properties are defined
  - Construction Settings
  - Material Settings
- Check if the spaces are placed throughout the model
- Check if the space types are defined

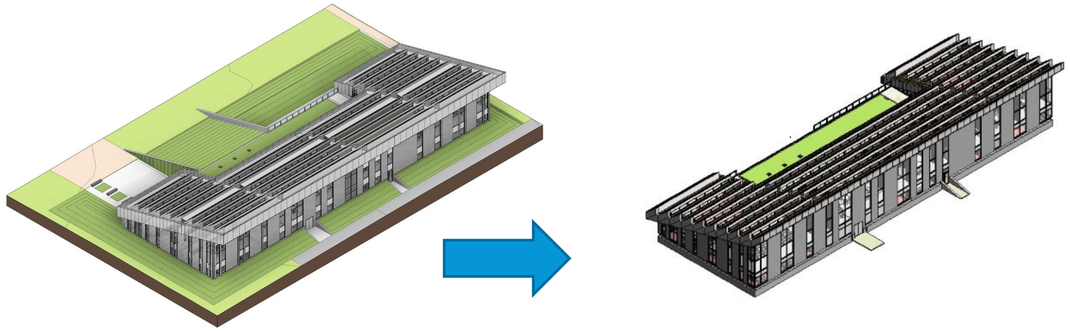




Best Practice

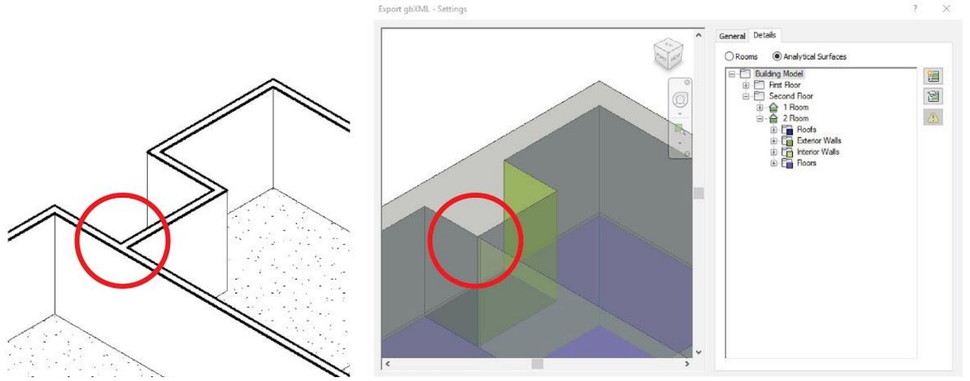
Before You Start

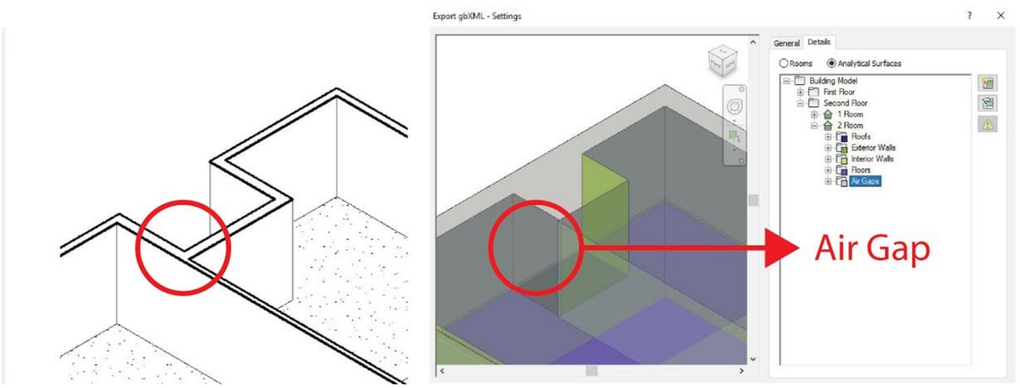
- Focus the model
  - Create your own Revit energy model view
  - Delete elements not required for energy analysis, such as railings and furnishings
  - Create your own schedules for BEM relevant elements



Best Practice Walls

- Place walls based on their centerlines;
- Substitute simple one layer for walls. Avoid multi-layers;
- Set walls that protrude into a space to “non-room bounding”;
- For gbXML exporting: revit constructions are not utilized by IES VE. therefore at the “Set Model Properties” dialog, identify these at the building and/ or room level
- For gbXML exporting: the same wall type used for the exterior can be used for the interior. The gbXML export process will differentiate between internal and external walls automatically





Best Practice Floors

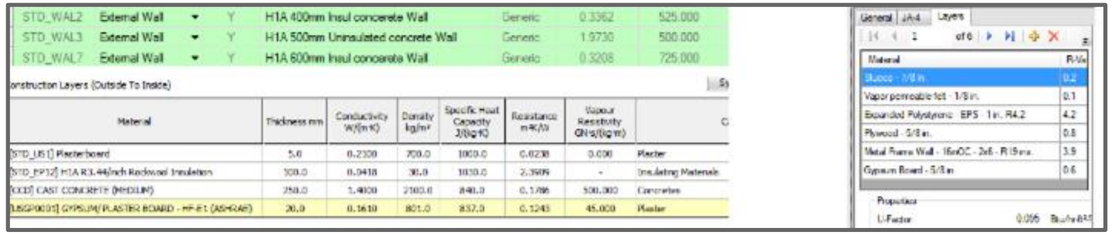
- Finished Floors: Avoid separately modeled finished floor or model the finished floors as non-room boundary.
- Outside Floors: Disable room bounding of outside floor elements such as plaza and walkways.
- Atriums: Avoid openings on the floors. Better to identify room on each floor separately.
- Attach Walls: After completing the floor, you will be prompted “Would you like walls that go up to this floor’s level to attach to its bottom?” Answer NO to this prompt.

Revit Envelope

<Exterior Wall Schedule>

A	B	C	D	E	F
Mark	Family	Type	Area	Heat Transfer Coefficient (U)	Thermal Resistance (R)
	Basic Wall	SCCC_Generic - 12" - Exterial	6,338.92 SF	0.0312 BTU/(h·ft²·°F)	32.0169 (h·ft²·°F)/BTU
	Basic Wall	SCCC_INSULATION - 2"	1,407.83 SF	0.2024 BTU/(h·ft²·°F)	4.9397 (h·ft²·°F)/BTU
	Basic Wall	SCCC_INSULATION - 5 1/4"	352.35 SF	0.0717 BTU/(h·ft²·°F)	13.9539 (h·ft²·°F)/BTU
	Basic Wall	SCCC_INSULATION - 8"	1,081.42 SF	0.0465 BTU/(h·ft²·°F)	21.4955 (h·ft²·°F)/BTU
	Basic Wall	SCCC_Roof 6"	1,543.81 SF	0.0601 BTU/(h·ft²·°F)	16.6417 (h·ft²·°F)/BTU

IES VE Envelope



eQuest Envelope

	Exterior Wall Name	Parent Space	Multiplier	X (ft)	Y (ft)	Z (ft)	Height (ft)	Width (ft)	Azimuth (deg)	Tilt (deg)	Location	Construction
64	EL2 North Wall (G.NE5.E6)	EL2 (FL2) Classroo	1	0.00	0.00	0.00	9.50	29.75	-180.00	90.00	V1 of Space Poly	PS710 60DD Exterior
65	EL2 North Wall (G.NW28.E25	EL2 Plenum NW Cla	1	0.00	29.25	0.00	3.50	29.25	-90.00	90.00	V8 of Space Poly	PS710 60DD Exterior
66	EL2 North Wall (G.NW7.E9)	EL2 (FL2) Classroo	1	0.00	29.25	0.00	9.50	29.25	-90.00	90.00	V8 of Space Poly	PS710 60DD Exterior
67	EL2 South Wall (G.SE1.E2)	EL2 (FL2) Classroo	1	0.00	29.50	0.00	9.50	29.50	-90.00	90.00	V8 of Space Poly	PS710 60DD Exterior
68	EL2 South Wall (G.SE22.E18	EL2 Plenum SE Clas	1	0.00	29.50	0.00	3.50	29.50	-90.00	90.00	V8 of Space Poly	PS710 60DD Exterior
69	EL2 South Wall (G.SW18.E14	EL2 (FL2) Classroo	1	0.00	0.00	0.00	9.50	29.50	-180.00	90.00	V1 of Space Poly	PS710 60DD Exterior
70	EL2 South Wall (G.SW39.E30	EL2 Plenum SW Cla	1	0.00	0.00	0.00	3.50	29.50	-180.00	90.00	V1 of Space Poly	PS710 60DD Exterior
71	EL2 West Wall (G.C16.E13)	EL2 (FL2) Corridor	1	0.00	0.00	0.00	9.50	9.10	-180.00	90.00	V1 of Space Poly	PS710 60DD Exterior
72	EL2 West Wall (G.C37.E29)	EL2 Plenum Corrido	1	0.00	0.00	0.00	3.50	9.10	-180.00	90.00	V1 of Space Poly	PS710 60DD Exterior
73	EL2 West Wall (G.NW28.E24	EL2 Plenum NW Cla	1	0.00	0.00	0.00	3.50	33.85	-180.00	90.00	V1 of Space Poly	PS710 60DD Exterior
74	EL2 West Wall (G.NW7.E8)	EL2 (FL2) Classroo	1	0.00	0.00	0.00	9.50	33.85	-180.00	90.00	V1 of Space Poly	PS710 60DD Exterior

Best Practice Spaces

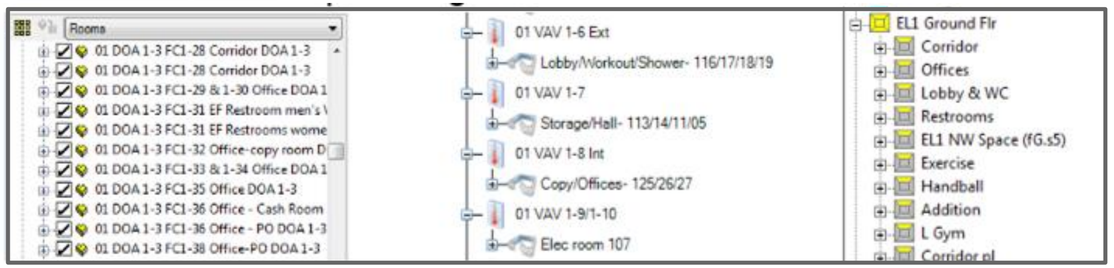
- Set Volume Computations to “Areas and Volumes”.
- Make sure spaces are placed throughout the entire model
  - In Visibility Graphics, turn on Spaces - In fill and reference
  - Visually check the model in plan view and in section view
  - Pay attention to shafts and chase walls
  - Create space schedule and remove undefined spaces
- Separate out room-bounding and non room-bounding
  - Focus the BEM model and turn off non-related elements
  - Check or uncheck room bounding elements when necessary
  - Verify all walls and floors are room bounding

Revit Space

<Space Schedule>

A	B	C	D	E	F	G	H	I
Name	Space Type	Area	Area per P	Specified Lighti	Specified Powe	Outdoor Air p	Outdoor Air pe	Specified Exh
Admin	BBJ Admin	2968 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF	0.00 CFM
Barber	BBJ Multi-purpos	602 SF	10 SF	0.40 W/ft²	0.50 W/ft²	7.5 CFM	0.06 CFM/SF	0.00 CFM
Cell	BBJ Cell	65693 SF	40 SF	0.64 W/ft²	0.10 W/ft²	5.0 CFM	0.06 CFM/SF	1.00 CFM
Central Control	BBJ Central Contr	5910 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF	0.00 CFM
Children's Play	BBJ Community	1423 SF	10 SF	0.62 W/ft²	1.00 W/ft²	7.5 CFM	0.12 CFM/SF	0.00 CFM
Clinic	BBJ Medical	15475 SF	50 SF	0.56 W/ft²	5.00 W/ft²	15.0 CFM	0.00 CFM/SF	
Community	BBJ Community	36374 SF	10 SF	0.62 W/ft²	1.00 W/ft²	7.5 CFM	0.12 CFM/SF	0.00 CFM
Concourse	BBJ Corridor	108192 SF	1000 SF	0.41 W/ft²	0.10 W/ft²	0.0 CFM	0.06 CFM/SF	0.00 CFM
Conference	BBJ Admin	1636 SF	200 SF	0.30 W/ft²	0.75 W/ft²	5.0 CFM	0.06 CFM/SF	0.00 CFM

IES VE Space

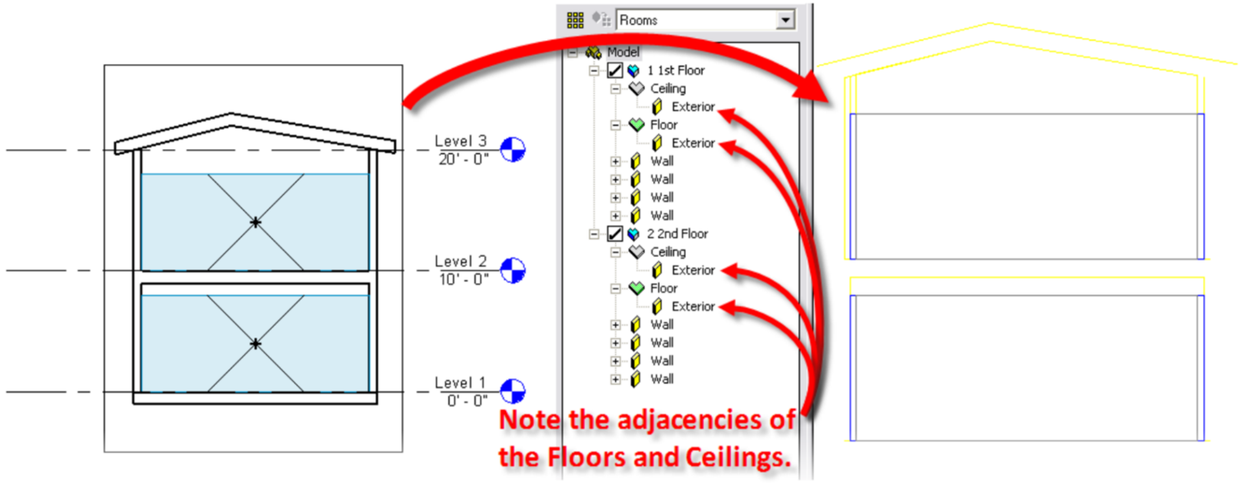


eQuest Space

	Space Name	Parent Floor	Activity Desc.	Occupancy Schedule	Area/Person (ft2)	Number of People	Total Ht Gain (Btu/h-person)	People Sens (Btu/h-person)	People Lat (Btu/h-person)
45	EL3 (FL3) Nurse's Office	EL3 Third floor	Healthcare - Exam	OFFICE-OCC-YR	58	1.00	450	250	200
46	EL1 (FL1) Warming Pantry	EL1 First floor	Food Preparation A	KITCHEN-OCC-YR	200	11.00	450	275	275
47	EL2 (FL2) Exercise Room	EL2 Second floor	Exercise Room	GYM-OCC-YR	17	31.00	450	710	1,090
48	EL1 (FL1) Domestic Water S	EL1 First floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
49	EL1 (FL1) Refuse/Recycle	EL1 First floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
50	EL2 (FL2) Telecom	EL2 Second floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
51	EL2 (FL2) Electrical Closet 2	EL2 Second floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200
52	EL3 (FL3) Electrical Closet 3	EL3 Third floor	Electrical/Mechanic	NULL-OCC-YR	300	0.00	450	250	200

Best Practice Spaces

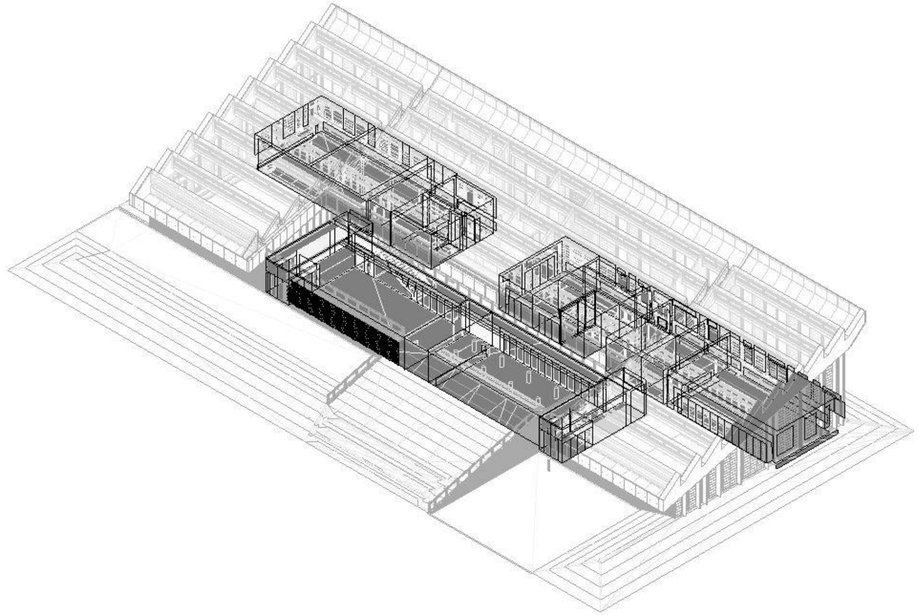
- Define all upper and lower boundaries of the spaces
  - Ceilings. Determine whether or not the plenum area is conditioned. If so, plenum area must be included in a space; If not, plenum area must be defined as a separate space.
  - Space offset on the level. Use a section to inspect the vertical shape of the space to ensure it is properly aligned. Ensure the space goes from top of slab to top of slab (level to level) with limit offset defined as zero. (no offset from the level)
  - Space offset above the roof. For spaces on the top floor, use a limit offset of 1’ so that the space rises above the roof element.

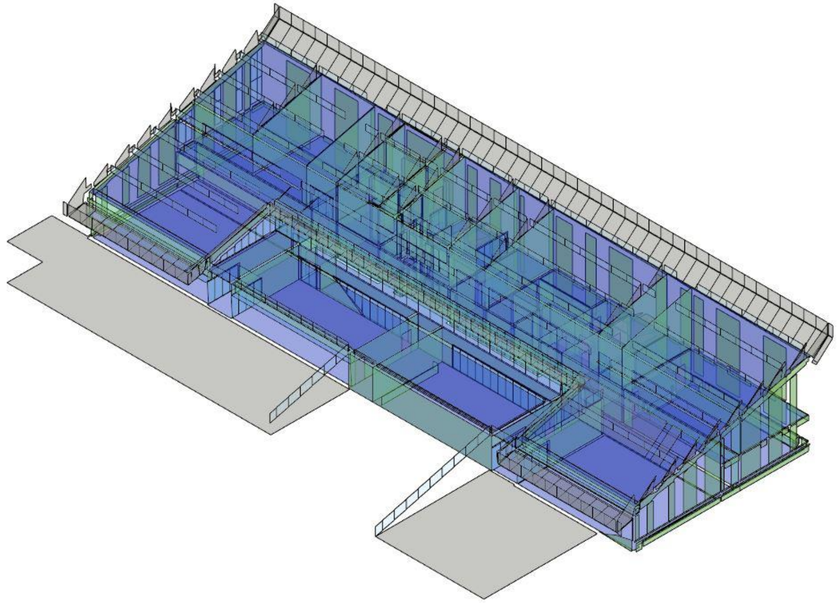


Resource: IES VE White Paper

Best Practice Troubleshooting

- Unexpected shades elements inside the model.
  - Make sure that there are no air gaps within the full external boundary
  - Lower analytical space and surface resolution if there are significant gaps in the model surface
- Model results are completely gray shaded spaces.
  - Be sure to specify the origin point somewhere in the center of the model
  - Transfer project standards from Revit default template to avoid overly complicated revit templates





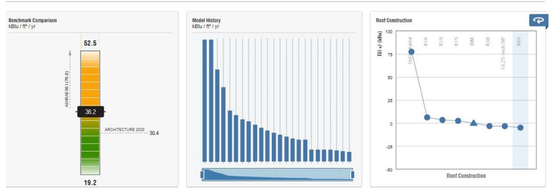
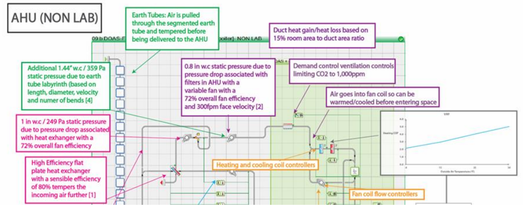
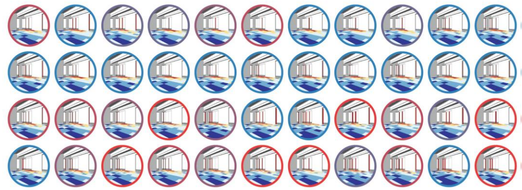
PICK N CHOOSE

Comparisons: Insight vs IES VE vs Honeybee

Learn the pros /cons when comparing Insight, IES VE, and Honeybee, and select the tool that is right for your project

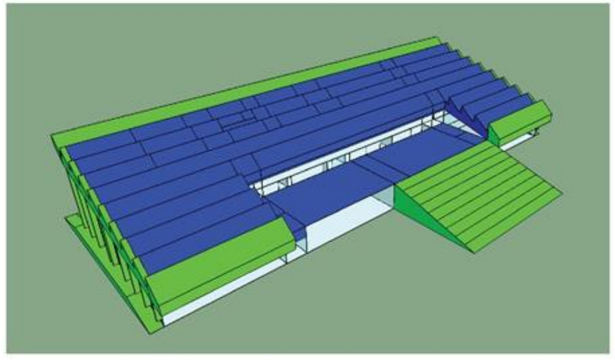
BIM solutions offer some of the energy modeling functionality today, but more is needed.

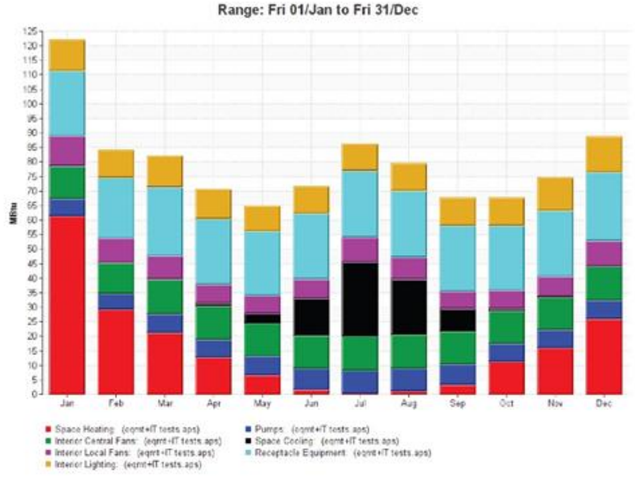
			
	Insight	IES VE	Honeybee
Design Tool/ **E**ngineering Tool	**D**	**E**	**D/E**
Architect/ **E**ngineer	**A/E**	**E**	**A**

	Insight	IES VE	Honeybee
APPLICATIONS	energy modeling. daylight analysis. solar study. heating/ cooling loads calculation. Cloud-based simulation. Revit Integration. customized zoning.	energy modeling. daylight analysis. solar study. heating/ cooling loads calculation. Revit Convertible. customized zoning. customized HVAC configuration.	energy modeling. daylight analysis. solar study. heating/ cooling loads. customized zoning. customized HVAC [w/ Ironburg]. customized visualization. parametric optimization.
SOFTWARE USES	Quick energy/ daylight analysis and high-level estimates. Guide design decision at early stages (SD). Understand the performance and provide feedback seamlessly throughout the design process.	Code compliance energy modeling and Net Zero Energy achievability verification (CD). Detailed thermal dynamic simulation with customized zoning and HVAC.	Multi-variable and Multi-objective energy/ daylight/ cost trade-off optimizations (DD). Customized visualization for presentation and communication.
			

	Insight	IES VE	Honeybee
APPLICATIONS	energy modeling. daylight analysis. solar study. heating/ cooling loads calculation. cloud based simulation. Revit Integration.	energy modeling. daylight analysis. solar study. heating/ cooling loads calculation. Revit Convertible. customized zoning. customized HVAC configuration.	energy modeling. daylight analysis. solar study. heating/ cooling loads. customized Zoning. customized HVAC [w/ Ironburg]. customized visualization. parametric optimization.
ACCURACY reliable results	high-level estimates. results for design purposes only.	high accuracy. results accepted for code compliance. and Net Zero verifications.	accuracy to be verified. results for design purposes only.
VERSATILITY customizable variables	limited options on HVAC types and configurations. limited options for results visualizations. limited capabilities of variations optimization.	customizable HVAC types and configurations. limited options for results visualizations. limited capabilities of variations optimization.	customizable HVAC types and configurations. customizable inputs, outputs, and visualizations. Multi-variable and Multi-objective energy/ daylight/ cost optimizations.
EFFICIENCY time saved	highly BIM integration with no data transfer needed. quick energy/ daylight analysis at early stages.	medium BIM integration. gbXML file exported from BIM is acceptable. massive additional time needed for customized scripts.	no BIM integration. additional time needed to import the BIM model. massive additional time needed for customized scripts.
ACCESSIBILITY quick learning time	Short. Simplified workflow. The user interface is straight forward.	Long. Demanding capabilities needed for mechanical engineering and energy modeling.	Long. Demanding capabilities needed for parametric modeling with grasshopper .

IES




Range: Fri 01/Jan to Fri 31/Dec
MBtu
Jan
Feb
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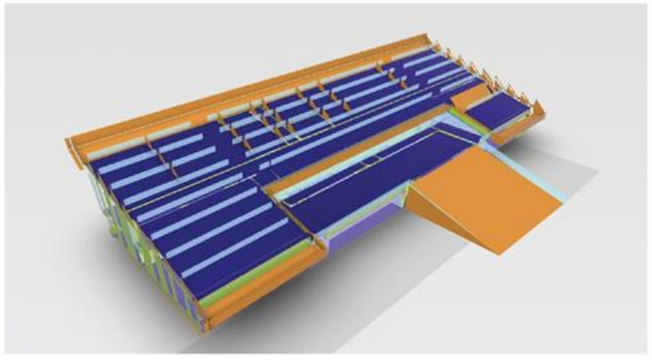
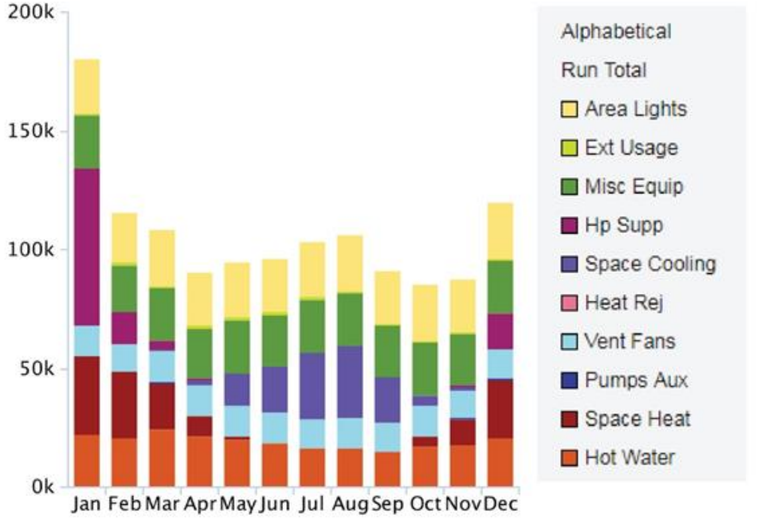
Space Heating: (eqmt+IT tests.aps)
Interior Central Fans: (eqmt+IT tests.aps)
Interior Local Fans: (eqmt+IT tests.aps)
Interior Lighting: (eqmt+IT tests.aps)
Pumps: (eqmt+IT tests.aps)
Space Cooling: (eqmt+IT tests.aps)
Receptacle Equipment: (eqmt+IT tests.aps)

Insight




200k
150k
100k
50k
0k
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Alphabetical
Run Total
Area Lights
Ext Usage
Misc Equip
Hp Supp
Space Cooling
Heat Rej
Vent Fans
Pumps Aux
Space Heat
Hot Water

PERFORMANCE

Develop Sustainability Workflow in BIM

Two New Questions

Question 4

No single software can cover all types of projects in all phases of design?

NO

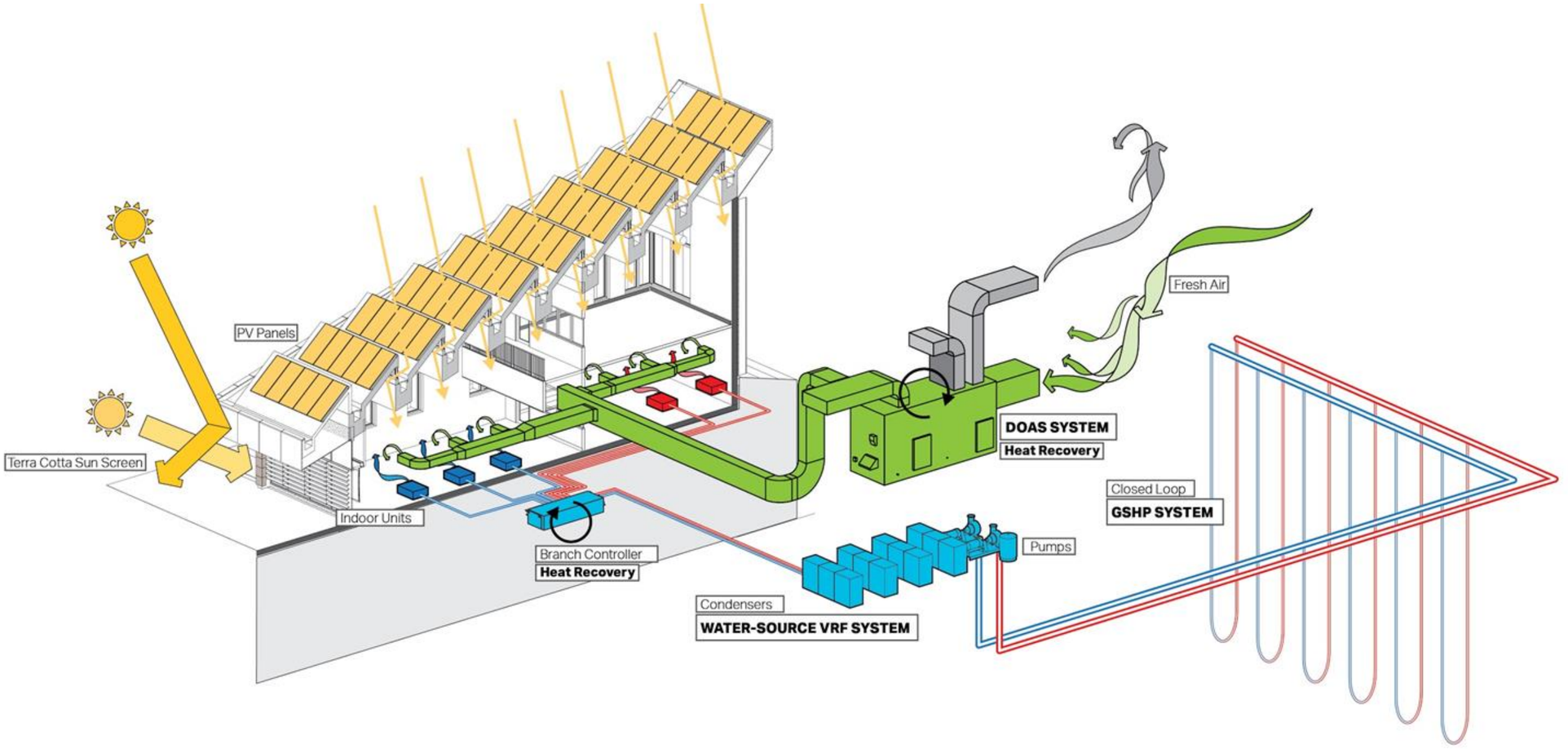
- A hybrid utilization of different BEM programs is needed with BIM integration.
- Multi-level capabilities are required for a high performance designer;
- Holistic thinking is also needed when driving a sustainability project.

Question 5

BIM or BEM data is not readily available from most manufacturers?

NO

- Energy-relevant specifications from equipment manufacturers are needed.
- BIM guidelines and templates should be developed for BEM with good assumptions made ready from a good database.



“Form follows performance, with the balancing of the budget.”

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